

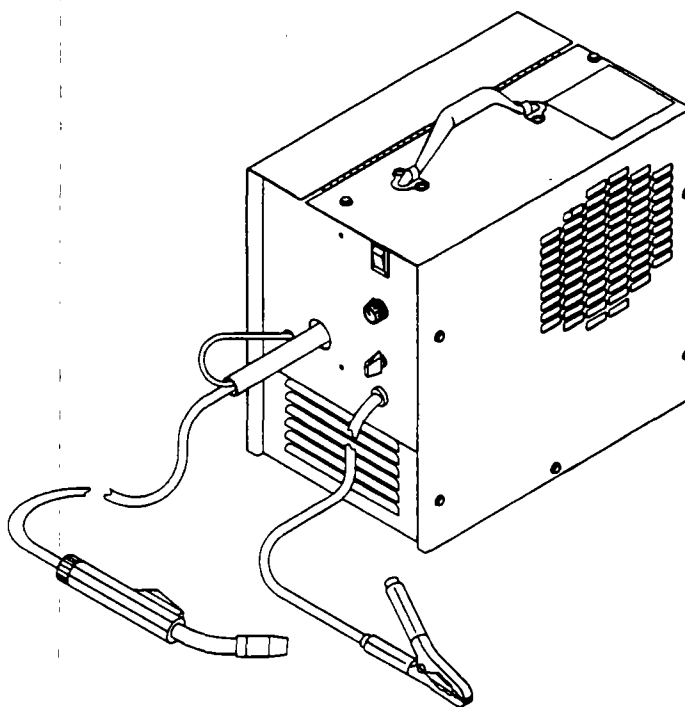


March 1991

FORM: OM-121 989B

Effective With Serial No. JK716660

**MODEL: BENCHMARK™
BENCHMARK™ Pro
MWG-160 Gun
AUTOARC 70
AUTO ARC 90**



OWNER'S MANUAL

IMPORTANT: Read and understand the entire contents of this manual, with special emphasis on the safety material throughout the manual, before installing, operating, or maintaining this equipment. This unit and these instructions are for use only by persons trained and experienced in the safe operation of welding equipment. Do not allow untrained persons to install, operate, or maintain this unit. Contact your distributor if you do not fully understand these instructions.

MILLER ELECTRIC Mfg. Co.
A Miller Group Ltd. Company

P.O. Box 1079
Appleton, WI 54912 USA
Tel. 414-734-9821

LIMITED WARRANTY

EFFECTIVE: AUGUST 6, 1990

This warranty supersedes all previous MILLER warranties and is exclusive with no other guarantees or warranties expressed or implied.

LIMITED WARRANTY – Subject to the terms and conditions hereof, MILLER Electric Mfg. Co., Appleton, Wisconsin warrants to its Distributor/Dealer that all new and unused Equipment furnished by MILLER is free from defect in workmanship and material as of the time and place of delivery by MILLER. No warranty is made by MILLER with respect to engines, trade accessories or other items manufactured by others. Such engines, trade accessories and other items are sold subject to the warranties of their respective manufacturers, if any. All engines are warranted by their manufacturer for two years from date of original purchase, except Deutz engines which have a one year, 2000 hour warranty.

Except as specified below, MILLER's warranty does not apply to components having normal useful life of less than one (1) year, such as spot welder tips, relay and contactor points, MILLERMATIC parts that come in contact with the welding wire including nozzles and nozzle insulators where failure does not result from defect in workmanship or material.

MILLER shall be required to honor warranty claims on warranted Equipment in the event of failure resulting from a defect within the following periods from the date of delivery of Equipment to the original user:

1. Arc welders, power sources, robots, and 1 year components
2. Load banks 1 year
3. Original main power rectifiers 3 years (labor – 1 year only)
4. All welding guns, feeder/guns and torches 90 days
5. All other MILLERMATIC Feeders 1 year
6. Replacement or repair parts, exclusive of labor 60 days
7. Batteries 6 months

provided that MILLER is notified in writing within thirty (30) days of the date of such failure.

As a matter of general policy only, MILLER may honor claims submitted by the original user within the foregoing periods.

In the case of MILLER's breach of warranty or any other duty with respect to the quality of any goods, the exclusive remedies therefore shall be, at MILLER's option (1) repair or (2) replacement or, where authorized in writing by MILLER in appropriate cases, (3) the reasonable cost of repair or replacement at an authorized MILLER service station or (4) payment of or credit for the purchase price (less reasonable depreciation based upon actual use) upon return of the goods at Customer's risk and expense. MILLER's option of repair or replacement will be F.O.B., Factory at Appleton, Wisconsin, or F.O.B. at a MILLER authorized service facility, therefore, no compensation for transportation costs of any kind will be allowed. Upon receipt of notice of apparent defect or failure, MILLER shall instruct the claimant on the warranty claim procedures to be followed.

ANY EXPRESS WARRANTY NOT PROVIDED HEREIN AND ANY IMPLIED WARRANTY, GUARANTY OR REPRESENTATION AS TO PERFORMANCE, AND ANY REMEDY FOR BREACH OF CONTRACT WHICH, BUT FOR THIS PROVISION, MIGHT ARISE BY IMPLICATION, OPERATION OF LAW, CUSTOM OF TRADE OR COURSE OF DEALING, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR PARTICULAR PURPOSE, WITH RESPECT TO ANY AND ALL EQUIPMENT FURNISHED BY MILLER IS EXCLUDED AND DISCLAIMED BY MILLER.

EXCEPT AS EXPRESSLY PROVIDED BY MILLER IN WRITING, MILLER PRODUCTS ARE INTENDED FOR ULTIMATE PURCHASE BY COMMERCIAL/INDUSTRIAL USERS AND FOR OPERATION BY PERSONS TRAINED AND EXPERIENCED IN THE USE AND MAINTENANCE OF WELDING EQUIPMENT AND NOT FOR CONSUMERS OR CONSUMER USE. MILLER'S WARRANTIES DO NOT EXTEND TO, AND NO RESELLER IS AUTHORIZED TO EXTEND MILLER'S WARRANTIES TO, ANY CONSUMER.

RECEIVING-HANDLING

Before unpacking equipment, check carton for any damage that may have occurred during shipment. File any claims for loss or damage with the delivering carrier. Assistance for filing or settling claims may be obtained from the distributor and/or the equipment manufacturer's Transportation Department.

When requesting information about this equipment, always provide the Model Description and Serial or Style Number.

Use the following spaces to record the Model Designation and Serial or Style Number of your unit. The information is located on the data card or the nameplate.

Model _____

Serial or Style No. _____

Date of Purchase _____

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SECTION 1 – SAFETY RULES FOR OPERATION OF ARC WELDING POWER SOURCE

1-1. INTRODUCTION

We learn by experience. Learning safety through personal experience, like a child touching a hot stove is harmful, wasteful, and unwise. Let the experience of others teach you.

Safe practices developed from experience in the use of welding and cutting are described in this manual. Research, development, and field experience have evolved reliable equipment and safe installation, operation, and servicing practices. Accidents occur when equipment is improperly used or maintained. The reason for the safe practices may not always be given. Some are based on common sense, others may require technical volumes to explain. It is wiser to follow the rules.

Read and understand these safe practices before attempting to install, operate, or service the equipment. Comply with these procedures as applicable to the particular equipment used and their instruction manuals, for personal safety and for the safety of others.

Failure to observe these safe practices may cause serious injury or death. When safety becomes a habit, the equipment can be used with confidence.

These safe practices are divided into two Sections: 1-General Precautions, common to arc welding and cutting; and 2-Arc Welding (and Cutting) (only).

Reference standards: Published Standards on safety are also available for additional and more complete procedures than those given in this manual. They are listed in the Standards Index in this manual. ANSI Z49.1 is the most complete.

The National Electrical Code, Occupational Safety and Health Administration, local industrial codes, and local inspection requirements also provide a basis for equipment installation, use, and service.

1-2. GENERAL PRECAUTIONS

Different arc welding processes, electrode alloys, and fluxes can produce different fumes, gases, and radiation levels. In addition to the information in this manual, be sure to consult flux and electrode manufacturers Material Safety Data Sheets (MSDSs) for specific technical data and precautionary measures concerning their material.

A. Burn Prevention

Wear protective clothing-gauntlet gloves designed for use in welding, hat, and high safety-toe shoes. Button shirt collar and pocket flaps, and wear cuffless trousers to avoid entry of sparks and slag.

Wear helmet with safety goggles and glasses with side shields underneath, appropriate filter lenses or plates (protected by clear cover glass). This is a **MUST** for welding or cutting, (and chipping) to protect the eyes

from radiant energy and flying metal. Replace cover glass when broken, pitted, or spattered. See 1-3A.2.

Avoid oily or greasy clothing. A spark may ignite them.

Hot metal such as electrode stubs and workpieces should never be handled without gloves.

Medical first aid and eye treatment. First aid facilities and a qualified first aid person should be available for each shift unless medical facilities are close by for immediate treatment of flash burns of the eyes and skin burns.

Ear plugs should be worn when working on overhead or in a confined space. A hard hat should be worn when others work overhead.

Flammable hair preparations should not be used by persons intending to weld or cut.

B. Toxic Fume Prevention

Severe discomfort, illness or death can result from fumes, vapors, heat, or oxygen enrichment or depletion that welding (or cutting) may produce. Prevent them with adequate ventilation as described in ANSI Standard Z49.1 listed in Standards Index. NEVER ventilate with oxygen.

Lead -, cadmium -, zinc -, mercury -, and beryllium-bearing and similar materials, when welded (or cut) may produce harmful concentrations of toxic fumes. Adequate local exhaust ventilation must be used, or each person in the area as well as the operator must wear an air-supplied respirator. For beryllium, both must be used.

Metals coated with or containing materials that emit toxic fumes should not be heated unless coating is removed from the work surface, the area is well ventilated and, if necessary, while wearing an air-supplied respirator.

Work in a confined space only while it is being ventilated and, if necessary, while wearing an air-supplied respirator.

Gas leaks in a confined space should be avoided. Leaked gas in large quantities can change oxygen concentration dangerously. Do not bring gas cylinders into a confined space.

Leaving confined space, shut OFF gas supply at source to prevent possible accumulation of gases in the space if downstream valves have been accidentally opened or left open. Check to be sure that the space is safe before re-entering it.

Vapors from chlorinated solvents can be decomposed by the heat of the arc (or flame) to form PHOSGENE, a highly toxic gas, and other lung and eye irritating products. The ultraviolet (radiant) energy of the arc can also decompose trichloroethylene and perchloroethylene vapors to form phosgene. **DO NOT WELD** or cut where solvent vapors can be drawn into the welding or cutting atmosphere or where the radiant energy can penetrate to atmospheres containing even minute amounts of trichloroethylene or perchloroethylene.

C. Fire and Explosion Prevention

Causes of fire and explosion are: combustibles reached by the arc, flame, flying sparks, hot slag or heated material; misuse of compressed gases and cylinders; and short circuits.

BE AWARE THAT flying sparks or falling slag can pass through cracks, along pipes, through windows or doors, and through wall or floor openings, out of sight of the goggled operator. Sparks and slag can fly 35 feet.

To prevent fires and explosion:

Keep equipment clean and operable, free of oil, grease, and (in electrical parts) of metallic particles that can cause short circuits.

If combustibles are in area, do NOT weld or cut. Move the work if practicable, to an area free of combustibles. Avoid paint spray rooms, dip tanks, storage areas, ventilators. If the work cannot be moved, move combustibles at least 35 feet away out of reach of sparks and heat; or protect against ignition with suitable and snug-fitting, fire-resistant covers or shields.

Walls touching combustibles on opposite sides should not be welded on (or cut). Walls, ceilings, and floor near work should be protected by heat-resistant covers or shields.

Fire watcher must be standing by with suitable fire extinguishing equipment during and for some time after welding or cutting if:

- a. appreciable combustibles (including building construction) are within 35 feet
- b. appreciable combustibles are further than 35 feet but can be ignited by sparks
- c. openings (concealed or visible) in floors or walls within 35 feet may expose combustibles to sparks
- d. combustibles adjacent to walls, ceilings, roofs, or metal partitions can be ignited by radiant or conducted heat.

Hot work permit should be obtained before operation to ensure supervisor's approval that adequate precautions have been taken.

After work is done, check that area is free of sparks, glowing embers, and flames.

An empty container that held combustibles, or that can produce flammable or toxic vapors when heated, must never be welded on or cut, unless container has first been cleaned as described in AWS Standard A6.0, listed 7 in Standards Index.

This includes: a thorough steam or caustic cleaning (or a solvent or water washing, depending on the combustible's solubility) followed by purging and inerting with nitrogen or carbon dioxide, and using protective equipment as recommended in A6.0. Waterfilling just below working level may substitute for inerting.

A container with unknown contents should be cleaned (see preceding paragraph). Do NOT depend on sense of smell or sight to determine if it is safe to weld or cut.

Hollow castings or containers must be vented before welding or cutting. They can explode.

Explosive atmospheres. Never weld or cut where the air may contain flammable dust, gas, or liquid vapors (such as gasoline).

D. Compressed Gas Equipment

Standard precautions. Comply with precautions in this manual, and those detailed in CGA Standard P-1, **SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS**, listed 11 in Standards Index.

1. Pressure Regulators

Regulator relief valve is designed to protect only the regulator from overpressure; it is not intended to protect any downstream equipment. Provide such protection with one or more relief devices.

Never connect a regulator to a cylinder containing gas other than that for which the regulator was designed.

Remove faulty regulator from service immediately for repair (first close cylinder valve). The following symptoms indicate a faulty regulator:

Leaks-if gas leaks externally.

Excessive Creep-if delivery pressure continues to rise with downstream valve closed.

Faulty Gauge-if gauge pointer does not move off stop pin when pressurized, nor returns to stop pin after pressure release.

Repair. Do NOT attempt to repair. Send faulty regulators for repair to manufacturer's designated repair center, where special techniques and tools are used by trained personnel.

2. Cylinders

Cylinders must be handled carefully to prevent leaks and damage to their walls, valves, or safety devices:

Avoid electrical circuit contact with cylinders including third rails, electrical wires, or welding circuits. They can produce short circuit arcs that may lead to a serious accident. (See 1-3C.)

ICC or DOT marking must be on each cylinder. It is an assurance of safety when the cylinder is properly handled.

Identifying gas content. Use only cylinders with name of gas marked on them; do not rely on color to identify gas content. Notify supplier if unmarked. NEVER DEFACE or alter name, number, or other markings on a cylinder. It is illegal and hazardous.

Empties: Keep valves closed, replace caps securely; mark MT; keep them separate from FULLS and return promptly.

Prohibited use. Never use a cylinder or its contents for other than its intended use, NEVER as a support or roller.

Locate or secure cylinders so they cannot be knocked over.

Passageways and work areas. Keep cylinders clear of areas where they may be struck.

Transporting cylinders. With a crane, use a secure support such as a platform or cradle. Do NOT lift cylinders off the ground by their valves or caps, or by chains, slings, or magnets.

Do NOT expose cylinders to excessive heat, sparks, slag, and flame, etc. that may cause rupture. Do not allow contents to exceed 130°F. Cool with water spray where such exposure exists.

Protect cylinders particularly valves from bumps, falls, falling objects, and weather. Replace caps securely when moving cylinders.

Stuck valve. Do NOT use a hammer or wrench to open a cylinder valve that can not be opened by hand. Notify your supplier.

Mixing gases. Never try to mix any gases in a cylinder.

Never refill any cylinder.

Cylinder fittings should never be modified or exchanged.

3. Hose

Prohibited use. Never use hose other than that designed for the specified gas. A general hose identification rule is: red for fuel gas, green for oxygen, and black for inert gases.

Use ferrules or clamps designed for the hose (not ordinary wire or other substitute) as a binding to connect hoses to fittings.

No copper tubing splices. Use only standard brass fittings to splice hose.

Avoid long runs to prevent kinks and abuse. Suspend hose off ground to keep it from being run over, stepped on, or otherwise damaged.

Coil excess hose to prevent kinks and tangles.

Protect hose from damage by sharp edges, and by sparks, slag, and open flame.

Examine hose regularly for leaks, wear, and loose connections. Immerse pressured hose in water; bubbles indicate leaks.

Repair leaky or worn hose by cutting area out and splicing (1-2D3). Do NOT tape.

4. Proper Connections

Clean cylinder valve outlet of impurities that may clog orifices and damage seats before connecting regulator. Except for hydrogen, crack valve momentarily, pointing

outlet away from people and sources of ignition. Wipe with a clean lintless cloth.

Match regulator to cylinder. Before connecting, check that the regulator label and cylinder marking area, and that the regulator inlet and cylinder outlet match. NEVER CONNECT a regulator designed for a particular gas or gases to a cylinder containing any other gas.

Tighten connections. When assembling threaded connections, clean and smooth seats where necessary. Tighten. If connection leaks, disassemble, clean, and retighten using properly fitting wrench.

Adapters. Use a CGA adapter (available from your supplier) between cylinder and regulator, if one is required. Use two wrenches to tighten adapter marked RIGHT and LEFT HAND threads.

Regulator outlet (or hose) connections may be identified by right hand threads for oxygen and left hand threads (with grooved hex on nut or shank) for fuel gas.

5. Pressurizing Steps:

Drain regulator of residual gas through suitable vent before opening cylinder (or manifold valve) by turning adjusting screw in (clockwise). Draining prevents excessive compression heat at high pressure seat by allowing seat to open on pressurization. Leave adjusting screw engaged slightly on single-stage regulators.

Stand to side of regulator while opening cylinder valve.

Open cylinder valve slowly so that regulator pressure increases slowly. When gauge is pressurized (gauge reaches regulator maximum) leave cylinder valve in following position: For oxygen, and inert gases, open fully to seal stem against possible leak. For fuel gas, open to less than one turn to permit quick emergency shutoff.

Use pressure charts (available from your supplier) for safe and efficient, recommended pressure settings on regulators.

Check for leaks on first pressurization and regularly thereafter. Brush with soap solution (capfull of Ivory Liquid* or equivalent per gallon of water). Bubbles indicate leak. Clean off soapy water after test; dried soap is combustible.

E. User Responsibilities

Remove leaky or defective equipment from service immediately for repair. See User Responsibility statement in equipment manual.

F. Leaving Equipment Unattended

Close gas supply at source and drain gas.

G. Rope Staging-Support

Rope staging-support should not be used for welding or cutting operation; rope may burn.

*Trademark of Proctor & Gamble.

1-3. ARC WELDING

Comply with precautions in 1-1, 1-2, and this section. Arc Welding, properly done, is a safe process, but a careless operator invites trouble. The equipment carries high currents at significant voltages. The arc is very bright and hot. Sparks fly, fumes rise, ultraviolet and infrared energy radiates, weldments are hot, and compressed gases may be used. The wise operator avoids unnecessary risks and protects himself and others from accidents. Precautions are described here and in standards referenced in index.

A. Burn Protection

Comply with precautions in 1-2.

The welding arc is intense and visibly bright. Its radiation can damage eyes, penetrate lightweight clothing, reflect from light-colored surfaces, and burn the skin and eyes. Skin burns resemble acute sunburn, those from gas-shielded arcs are more severe and painful. **DON'T GET BURNED; COMPLY WITH PRECAUTIONS.**

1. Protective Clothing

Wear long-sleeve clothing (particularly for gas-shielded arc) in addition to gloves, hat, and shoes (1-2A). As necessary, use additional protective clothing such as leather jacket or sleeves, flame-proof apron, and fire-resistant leggings. Avoid outer garments of untreated cotton.

Bare skin protection. Wear dark, substantial clothing. Button collar to protect chest and neck and button pockets to prevent entry of sparks.

2. Eye and Head Protection

Protect eyes from exposure to arc. **NEVER** look at an electric arc without protection.

Welding helmet or shield containing a filter plate shade no. 12 or denser must be used when welding. Place over face before striking arc.

Protect filter plate with a clear cover plate.

Cracked or broken helmet or shield should **NOT** be worn; radiation can pass through to cause burns.

Cracked, broken, or loose filter plates must be replaced **IMMEDIATELY**. Replace clear cover plate when broken, pitted, or spattered.

Flash goggles with side shields **MUST** be worn under the helmet to give some protection to the eyes should the helmet not be lowered over the face before an arc is struck. Looking at an arc momentarily with unprotected eyes (particularly a high intensity gas-shielded arc) can cause a retinal burn that may leave a permanent dark area in the field of vision.

3. Protection of Nearby Personnel

Enclosed welding area. For production welding, a separate room or enclosed bay is best. In open areas, surround the operation with low-reflective, non-combustible screens or panels. Allow for free air circulation, particularly at floor level.

Viewing the weld. Provide face shields for all persons who will be looking directly at the weld.

Others working in area. See that all persons are wearing flash goggles.

Before starting to weld, make sure that screen flaps or bay doors are closed.

B. Toxic Fume Prevention

Comply with precautions in 1-2B.

Generator engine exhaust must be vented to the outside air. Carbon monoxide can kill.

C. Fire and Explosion Prevention

Comply with precautions in 1-2C.

Equipment's rated capacity. Do not overload arc welding equipment. It may overheat cables and cause a fire.

Loose cable connections may overheat or flash and cause a fire.

Never strike an arc on a cylinder or other pressure vessel. It creates a brittle area that can cause a violent rupture or lead to such a rupture under rough handling.

D. Compressed Gas Equipment

Comply with precautions in 1-2D.

E. Shock Prevention

Exposed hot conductors or other bare metal in the welding circuit, or in ungrounded, electrically-HOT equipment can fatally shock a person whose body becomes a conductor. **DO NOT STAND, SIT, LIE, LEAN ON, OR TOUCH** a wet surface when welding, without suitable protection.

To protect against shock:

Wear dry insulating gloves and body protection. Keep body and clothing dry. Never work in damp area without adequate insulation against electrical shock. Stay on a dry duckboard, or rubber mat when dampness or sweat can not be avoided. Sweat, sea water, or moisture between body and an electrically HOT part or grounded metal reduces the electrical resistance, and could enable dangerous and possibly lethal currents to flow through the body.

A voltage will exist between the electrode and any conducting object in the work circuit. Examples of conducting objects include, but are not limited to, buildings, electrical tools, work benches, welding power source cases, workpieces, etc. **Never touch the electrode and any metal object unless the welding power source is off.**

1. Grounding the Equipment

Arc welding equipment must be grounded according to the National Electrical Code, and the work must be grounded according to ANSI Z49.1 "Safety In Welding And Cutting."

When installing, connect the frames of each unit such as welding power source, control, work table, and water circulator to the building ground. Conductors must be adequate to carry ground currents safely. Equipment made

electrically HOT by stray current may shock, possibly fatally. Do NOT GROUND to electrical conduit, or to a pipe carrying ANY gas or flammable liquid such as oil or fuel.

Three-phase connection. Check phase requirements of equipment before installing. If only 3-phase power is available, connect single-phase equipment to only two wires of the 3-phase line. Do NOT connect the equipment ground lead to the third (live) wire, or the equipment will become electrically HOT—a dangerous condition that can shock, possibly fatally.

Before welding, check ground for continuity. Be sure conductors are touching bare metal of equipment frames at connections.

If a line cord with a ground lead is provided with the equipment for connection to a switchbox, connect the ground lead to the grounded switchbox. If a three-prong plug is added for connection to a grounded mating receptacle, the ground lead must be connected to the ground prong only. If the line cord comes with a three-prong plug, connect to a grounded mating receptacle. Never remove the ground prong from a plug, or use a plug with a broken off ground prong.

2. Electrode Holders

Fully insulated electrode holders should be used. Do NOT use holders with protruding screws.

3. Connectors

Fully insulated lock-type connectors should be used to join welding cable lengths.

4. Cables

Frequently inspect cables for wear, cracks and damage. IMMEDIATELY REPLACE those with excessively worn or damaged insulation to avoid possibly-lethal shock from bared cable. Cables with damaged areas may be taped to give resistance equivalent to original cable.

Keep cable dry, free of oil and grease, and protected from hot metal and sparks.

5. Terminals And Other Exposed Parts

Terminals and other exposed parts of electrical units should have insulating covers secured before operation.

6. Electrode

a. Equipment with output on/off control (contactor)

Welding power sources for use with the gas metal arc welding (GMAW), gas tungsten arc welding (GTAW) and similar processes normally are equipped with devices that permit on-off control of the welding power output. When so equipped the electrode wire becomes electrically HOT when the power source switch is ON and the welding gun switch is closed. Never touch the electrode wire or any conducting object in contact with the electrode circuit unless the welding power source is off.

b. Equipment without output on/off control (no contactor)

Welding power sources used with shielded metal arc welding (SMAW) and similar processes may not be equipped with welding power output on-off control devices. With such equipment the electrode is electrically HOT when the power switch is turned ON. Never touch the electrode unless the welding power source is off.

7. Safety Devices

Safety devices such as interlocks and circuit breakers should not be disconnected or shunted out.

Before installation, inspection, or service, of equipment, shut OFF all power and remove line fuses (or lock or red-tag switches) to prevent accidental turning ON of power. Disconnect all cables from welding power source, and pull all 115 volts line-cord plugs.

Do not open power circuit or change polarity while welding. If, in an emergency, it must be disconnected, guard against shock burns, or flash from switch arcing.

Leaving equipment unattended. Always shut OFF and disconnect all power to equipment.

Power disconnect switch must be available near the welding power source.

F. Protection For Wearers of Electronic Life Support Devices (Pacemakers)

Magnetic fields from high currents can affect pacemaker operation. Persons wearing electronic life support equipment (pacemaker) should consult with their doctor before going near arc welding, gouging, or spot welding operations.

1-4. STANDARDS BOOKLET INDEX

For more information, refer to the following standards or their latest revisions and comply as applicable:

1. ANSI Standard Z49.1, SAFETY IN WELDING AND CUTTING obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126.
2. NIOSH, SAFETY AND HEALTH IN ARC WELDING AND GAS WELDING AND CUTTING obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
3. OSHA, SAFETY AND HEALTH STANDARDS, 29CFR 1910, obtainable from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.
4. ANSI Standard Z87.1, SAFE PRACTICES FOR OCCUPATION AND EDUCATIONAL EYE AND FACE PROTECTION obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.
5. ANSI Standard Z41.1, STANDARD FOR MEN'S SAFETY-TOE FOOTWEAR obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

6. ANSI Standard Z49.2, FIRE PREVENTION IN THE USE OF CUTTING AND WELDING PROCESSES obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.
7. AWS Standard A6.0, WELDING AND CUTTING CONTAINERS WHICH HAVE HELD COMBUSTIBLES obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126.
8. NFPA Standard 51, OXYGEN-FUEL GAS SYSTEMS FOR WELDING, CUTTING, AND ALLIED PROCESSES obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
9. NFPA Standard 70, NATIONAL ELECTRICAL CODE obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
10. NFPA Standard 51B, CUTTING AND WELDING PROCESSES obtainable from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.
11. CGA Pamphlet P-1, SAFE HANDLING OF COMPRESSED GASES IN CYLINDERS obtainable from the Compressed Gas Association, 1235 Jefferson Davis Highway, Suite 501, Arlington, VA 22202.
12. CSA Standard W117.2, CODE FOR SAFETY IN WELDING AND CUTTING obtainable from the Canadian Standards Association, Standards Sales, 178 Rexdale Boulevard, Rexdale, Ontario, Canada M9W 1R3.
13. NWSA booklet, WELDING SAFETY BIBLIOGRAPHY obtainable from the National Welding Supply Association, 1900 Arch Street, Philadelphia, PA 19103.
14. American Welding Society Standard AWSF4.1, RECOMMENDED SAFE PRACTICES FOR THE PREPARATION FOR WELDING AND CUTTING OF CONTAINERS AND PIPING THAT HAVE HELD HAZARDOUS SUBSTANCES, obtainable from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126.
15. ANSI Standard Z88.2, PRACTICE FOR RESPIRATORY PROTECTION, obtainable from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

SECTION 2 – SAFETY PRECAUTIONS AND SIGNAL WORDS

2-1. GENERAL INFORMATION AND SAFETY

A. General

Information presented in this manual and on various labels, tags, and plates on the unit pertains to equipment design, installation, operation, maintenance, and troubleshooting which should be read, understood, and followed for the safe and effective use of this equipment.

The nameplate of this unit uses international symbols for labeling the front panel controls. The symbols also appear at the appropriate section in the text.

B. Safety

The installation, operation, maintenance, and troubleshooting of arc welding equipment requires practices and procedures which ensure personal safety and the safety of others. Therefore, this equipment is to be installed, operated, and maintained only by qualified persons in accordance with this manual and all applicable codes such as, but not limited to, those listed at the end of Section 1 – Safety Rules For Operation Of Arc Welding Power Source.

2-2. SAFETY ALERT SYMBOL AND SIGNAL WORDS

The following safety alert symbol and signal words are used throughout this manual to call attention to and identify different levels of hazard and special instructions.



This safety alert symbol is used with the signal words **WARNING** and **CAUTION** to call attention to the safety statements.



WARNING statements identify procedures or practices which must be followed to avoid serious personal injury or loss of life.



CAUTION statements identify procedures or practices which must be followed to avoid minor personal injury or damage to this equipment.

IMPORTANT statements identify special instructions necessary for the most efficient operation of this equipment.

SECTION 3 – SPECIFICATIONS

Table 3-1. Specifications

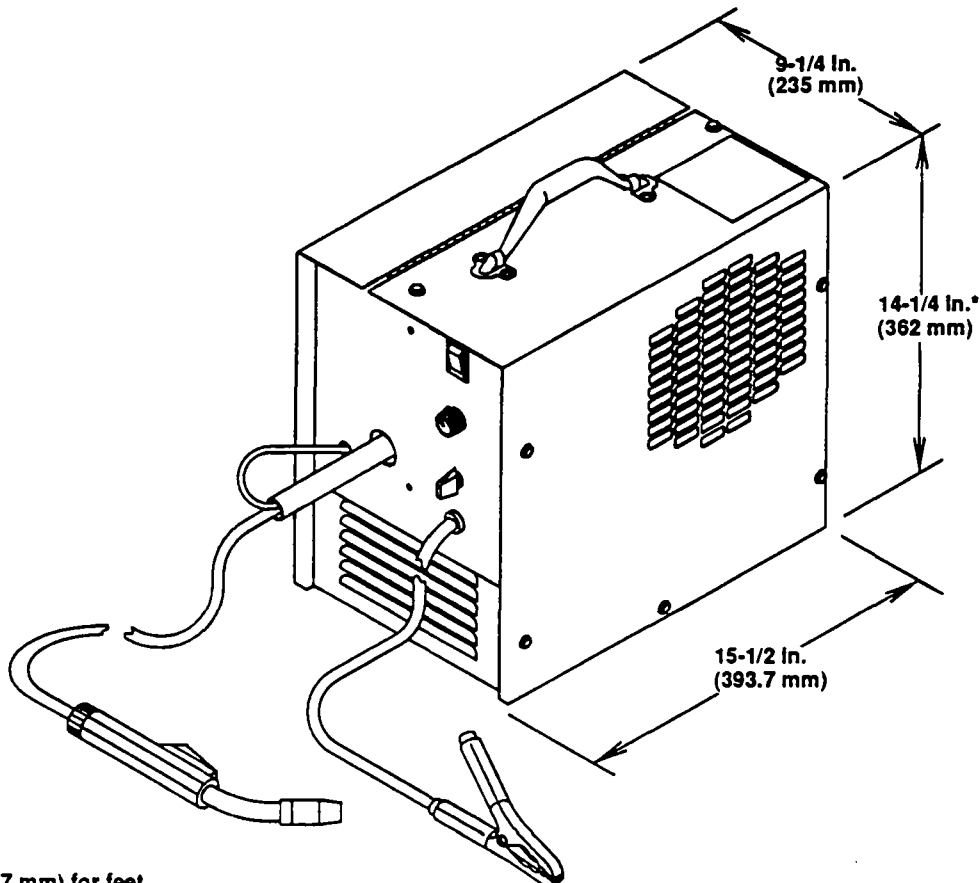
Wire Welder

Model	Rated Weld Output At 20% Duty Cycle	Max. Open-Circuit Voltage	Input At Rated Load Output 60 Hz Single-Phase				Control Circuit Voltage At Gun	Electrode Wire Feed Speed	Electrode Wire Diameter Capability	Weight		
			Amperes At		kva					kw	Net	Ship
			115V	230V								
70 Ampere	70 Amperes At 17 Volts DC	29	15	7.5	2.2	2	24 Volts DC	28 to 163 ipm (0.7 to 4.1 mpm)	.023 (0.58 mm) to .035 (0.89 mm)	53 lbs.* (24 kg)	62 lbs. (28 kg)	
90 Ampere	90 Amperes At 18 Volts DC	30	20	10	3	2.2		550 to 716 ipm (13.8 to 17.9 mpm)		68 lbs.* (31 kg)	72 lbs. (33 kg)	

*Includes gun.

Gun

Ampere Rating With CO ₂ 60% Duty Cycle	Wire Diameter	Cable Length	Cooling Method
160 Amperes	.023 (0.58 mm) to .035 (0.89 mm)	10 ft. (3.05 m)	Air



*Add 1/2 in. (12.7 mm) for feet.

Figure 3-1. Overall Dimensions

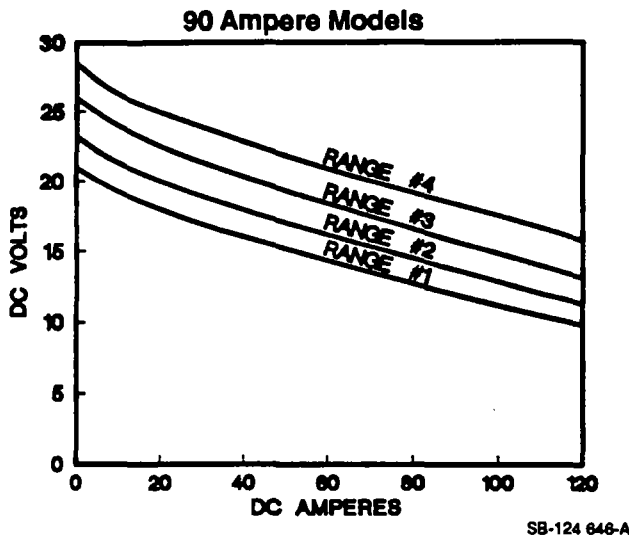
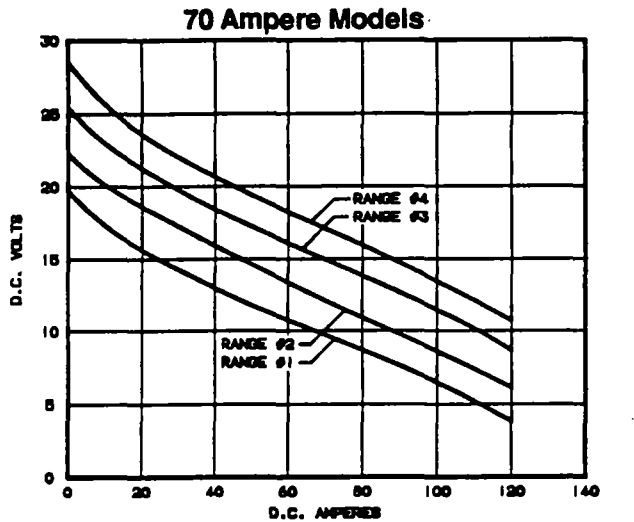
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3-1. VOLT-AMPERE CURVES (Chart 3-1)



The volt-ampere curves show the minimum and maximum voltage and amperage output capabilities of the unit from the minimum and maximum settings of the FINE TUNING/WIRE SPEED control.

Chart 3-1. Volt-Ampere Curves



3-2. DUTY CYCLE

A. Wire Welder (Chart 3-2)

The duty cycle of a wire welder is the percentage of a ten minute period that the welder can be operated at a given load.

The wire welder is rated at 20 percent duty cycle; therefore, the unit can be operated at rated load for two consecutive minutes out of ten, but it must idle for the remaining eight minutes to allow proper cooling.

Refer to the Duty Cycle Chart (Chart 3-2) to determine the output of the welder at various duty cycles.

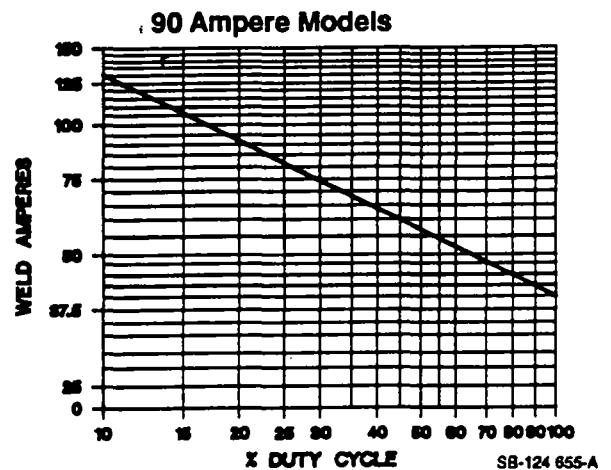
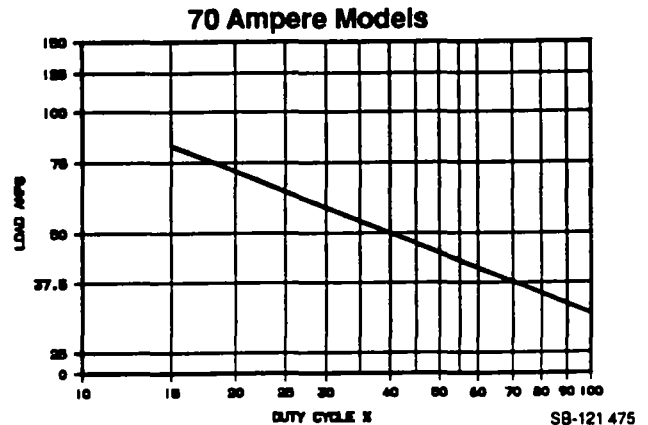
IMPORTANT: Decreasing welding amperes increases duty cycle.



CAUTION: EXCEEDING DUTY CYCLE RATINGS will damage the wire welder.

- Do not exceed indicated duty cycles.

Chart 3-2. Duty Cycle



B. Welding Gun

The duty cycle of a welding gun is the percentage of a ten minute period that a gun can be operated at a given load. This gun is rated at 60% duty cycle using CO₂ shielding gas. This means that the gun can be operated six minutes out of every ten with the CO₂ shielding gas. The remaining four minutes the gun should be idle to permit proper cooling.



CAUTION: EXCEEDING THE RATED AMPERAGE WITH CO₂ OR FAILING TO REDUCE THE WELDING AMPERAGE OR DUTY CYCLE WHEN USING A MIXED SHIELDING GAS can result in damage to the gun.

- Do not exceed rated amperage when using CO₂.
- Operate at 30% duty cycle when using mixed shielding gases such as carbon dioxide and argon.

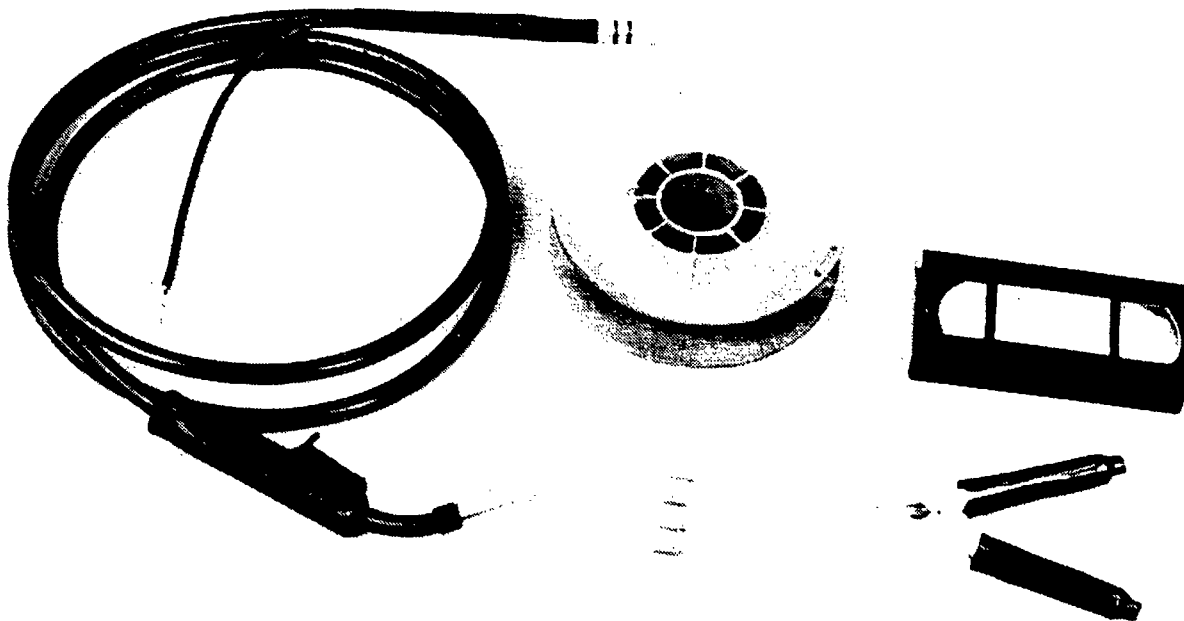


Figure 3-2. Supplied Equipment

3-3. DESCRIPTION

This unit is a single-phase, constant voltage, dc arc welding power source/wire feeder. The wire feed system is designed for Gas Metal Arc Welding (GMAW or MIG) with .023 to 0.025 in. (0.58 to 0.64 mm) hard wire. The unit can also be used for Flux Cored Arc Welding (FCAW) with .030 in. (0.76 mm) and .035 in. (0.89 mm) flux cored welding wire.

The 70 Ampere model is used with a supplied MWG-160 gun. Rated output of this model is 70 amperes, 17 volts dc, at 20% duty cycle.

The 90 Ampere model is used with a supplied MWG-160 gun. Rated output of this model is 90 amperes, 18 volts dc, at 20% duty cycle.

3-4. SUPPLIED EQUIPMENT (Figure 3-2)

The following equipment has been included with the welder:

1. One welding gun.
2. Five contact tubes.
3. One work clamp.
4. One, 2 lb. (0.91 kg) spool of .023 in. (0.58 mm) AWS Class E70S-6 steel wire.
5. One, 28 minute VHS video tape.

The welder is factory equipped with a 7 ft. (2.1 m) input power cord with plug.

3-5. PERSONAL SAFETY EQUIPMENT (Figure 3-3)

Wear a welding helmet with a #10 lens to protect the eyes from the welding arc. Also wear protective clothing, safety glasses, and gloves to protect from injury.

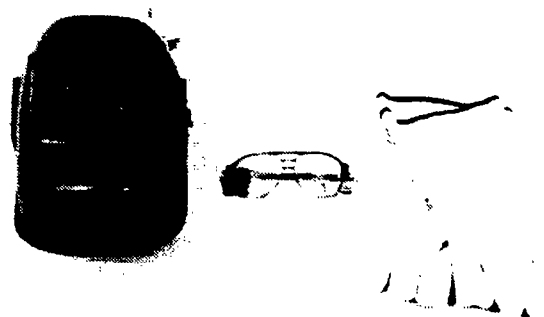


Figure 3-3. Personal Safety Equipment

3-6. ADDITIONAL REQUIRED EQUIPMENT

The following is a list of additional equipment that is required for Gas Metal Arc Welding (GMAW).

A. Gas Cylinder

Two types of gas are generally used with Gas Metal Arc Welding (GMAW) of thin gauge sheet steel. Carbon dioxide (CO₂) is the gas recommended for use with this wire welder/gun combination. A mixture of 75 percent argon and 25 percent carbon dioxide also gives favorable results. Obtain a cylinder of selected welding gas from your supplier.

B. Regulator/Flowmeter

The Regulator/flowmeters provide a constant shielding gas pressure and flow rate during the welding process. Because gases have different properties, each regulator/flowmeter is designed to be used with a specific gas or mixture of gases. Regulator/flowmeters cannot be changed from one gas to another unless the proper adapters are installed. Obtain the proper regulator/flowmeter for the type of gas used.

C. Gas Hose

Measure the distance from the gas cylinder to the wire welder. Obtain good quality 5/8 in. (16 mm) O.D. S.A.E. gas hose, and install 5/8-18 right-hand thread fittings on both ends of hose.

D. Spool Of Wire

Selection of the correct welding wire is important in Gas Metal Arc Welding (GMAW). There are many types to choose from, but certain wires are best suited for welding thin gauge sheet steel. The American Welding Society (AWS) classification for GMAW wires is usually indicated on the label of the wire spool. Two AWS wire classes recommended are E70S-6 and E70S-3. The E70S-6 provides a more fluid (wetter) weld puddle and a flatter bead; however, E70S-3 is acceptable for use with

this welder. E70S-6 is the recommended wire for welding high strength steel in auto collision repair applications, and is supplied with this unit.

3-7. CONSUMABLE/REPLACEMENT PARTS

The following parts are subject to wear or use under normal welding conditions.

1. Wire
2. Contact tubes
3. Nozzles
4. Drive rolls
5. Liner

Spare parts are available from welding equipment distributors.

SECTION 4 – INSTALLATION OR RELOCATION

4-1. LOCATE THE WELDER (Figure 3-1)



CAUTION: RESTRICTED AIRFLOW causes overheating and possible damage to internal parts.

- *Maintain at least 18 inches (457 mm) of unrestricted space on all sides of unit, and keep underside free of obstructions.*

- *Do not place any filtering device over the intake air passages of this welding generator.*

Warranty is void if any type of filtering device is used.

The welder should be positioned to provide adequate airflow for cooling during operation and to allow room to open the access door for installation and adjustment procedures.

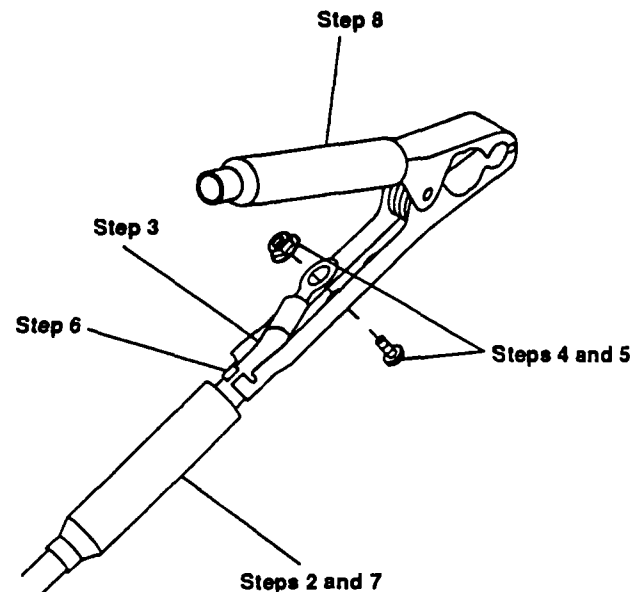
The service life and efficiency of this unit are reduced when the unit is subjected to high levels of dust, dirt, moisture, corrosive vapors, or extreme heat.

4-2. INSTALL THE WORK CLAMP (Figure 4-1)

A 10 ft. (3 m) work cable with lug extends from the front of the unit. Install the supplied work clamp onto the cable as follows:

1. Turn OFF the welder.
2. Slide one of the supplied insulating sleeves over the end of the work cable.
3. Place the end of the work cable into either work clamp handle.

4. Align the smaller hole in the handle with the hole in the work cable terminal lug.
5. Secure the terminal lug to the clamp with the supplied nut and bolt.
6. Bend the tabs on the end of the handle around the work cable.
7. Slide the insulating sleeve on the cable over the handle.
8. Slide the remaining insulating sleeve over the other work clamp handle.



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Figure 4-1. Work Clamp Installation

4-3. SET THE WELDING POLARITY (Figure 4-2)



WARNING: ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Turn off welder, and remove input power plug from receptacle before inspecting or changing connections.

HOT SURFACES can cause severe burns.

- Allow equipment to cool before inspecting or changing connections.

IMPORTANT: Read and follow the electrode manufacturer's recommended welding procedures.

This welding power source has jumper links that allow the user to select the polarity of the unit. The jumper links can be positioned for Reverse Polarity (DCEP) or Straight Polarity (DCEN) welding (see Figure 4-2). The unit was shipped with the links positioned for Reverse Polarity (DCEP) for use with the Gas Metal Arc Welding (GMAW) process.

If Fluxed Cored Arc Welding (FCAW) is desired, position jumper links for Straight Polarity (DCEN). Know the recommended polarity for the wire you are using.

The jumper links are located behind the left side door. The gun polarity changeover label (Figure 4-2) is located directly to the left of the links. If it is necessary to change jumper link positions, proceed as follows:

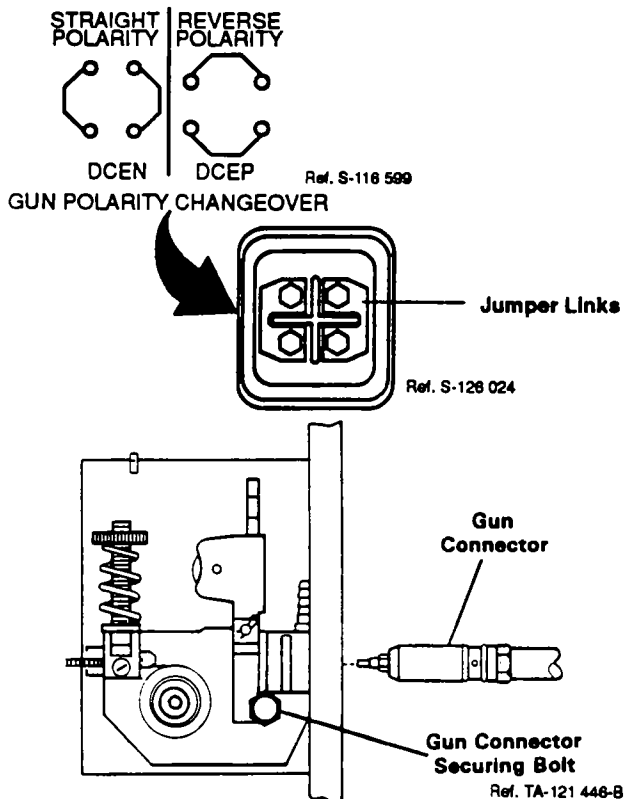


Figure 4-2. Gun Polarity Changeover Label And Gun Installation

1. Turn OFF the welder.
2. Open the left side access door.
3. Loosen the hardware securing the jumper links.
4. Reposition the jumper links and tighten the securing hardware.
5. Close and secure the access door.

4-4. INSTALL THE WELDING GUN

A. Connect The Gun Cable (Figure 4-2)

1. Turn OFF the welder.
2. Open the left side access door.
3. Loosen the gun cable connector securing bolt on the drive assembly.

IMPORTANT: Wire guides should be installed so that the tip(s) of the guide is as close to the drive roll as possible without touching.

4. Insert the gun cable through the large access hole on the front panel. Slide the connector into the drive assembly until the connector hex stop is flush against the drive assembly.
5. Tighten the gun cable connector securing bolt.

B. Connect The Gun Trigger Leads

1. Locate the two leads hanging free from the gun cable.
2. Route these leads through the small access hole on the front panel.
3. Securely connect the leads to the matching leads behind the panel.
4. Close and secure the side access door.

4-5. INSTALL AND THREAD THE WIRE (Figures 4-3 And 4-4)



CAUTION: LOOSE WELDING WIRE can cause injury.

- Keep firm hold on wire during installation, removal, and threading operations.

Spooled wire has a tendency to unravel rapidly when loosened from the spool.

A two pound spool of AWS Class E70S-6 steel wire, size .023, has been shipped installed on the hub of the welder. Additional wire can be purchased from welding equipment distributors. To install a spool of wire, proceed as follows:

1. Turn OFF the welder.
2. Open the left side access door.

IMPORTANT: If using factory installed wire spool, proceed to Step 7.

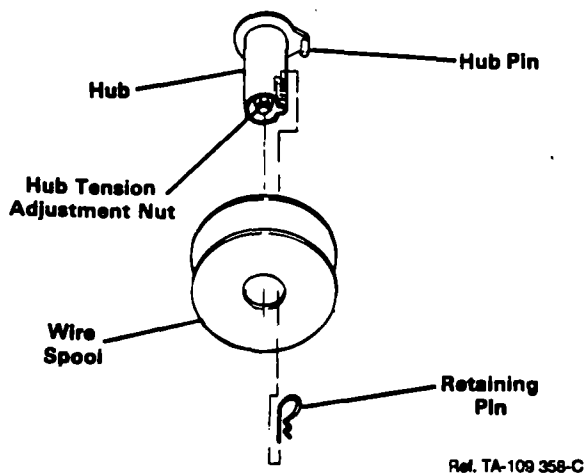


Figure 4-3. Wire Spool Installation

3. Remove the retaining pin from the hub and remove the empty wire spool.
4. Slide the spool of wire onto the hub so that the wire feeds off the bottom of the spool.
5. Rotate the spool until the hole in the spool aligns with the pin on the hub. Slide the spool onto the pin until it seats firmly on the back flange of the hub.
6. Reinstall the retaining pin onto the hub in the slot closest to the spool to prevent the spool from sliding during operation.
7. Loosen the drive roll pressure adjustment knob, pivot the pressure adjustment arm down, away from the cover. Pivot the pressure roll assembly up until it is in the open position. See Figure 4-4.
8. Cut off any wire that is bent, and remove any burrs or sharp edges.

9. Unreel and straighten approximately 6 in. (152 mm) of wire from the spool.
10. Route the welding wire into the wire inlet guide, along the drive roll groove, and into the wire outlet guide in the gun cable.
11. Make sure the wire is riding in the drive roll groove. Pivot the pressure roll assembly down onto the drive roll.
12. Pivot the pressure adjustment arm up until it seats on top of the pressure roll assembly.
13. Turn the pressure adjustment knob clockwise until the drive roll assembly is secure. Adjust the drive roll pressure just enough to prevent the wire from slipping on or against the drive roll during operation.



CAUTION: EXCESSIVE DRIVE ROLL TENSION can damage wire and equipment and cause poor wire feeding.

- Do not overtighten drive roll pressure adjustment knob.

4-6. ADJUST THE HUB TENSION (Figure 4-3)

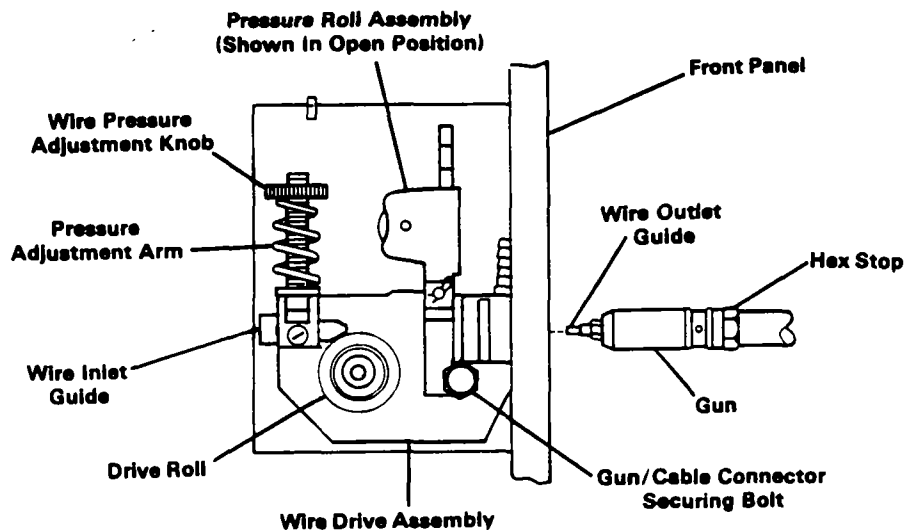


CAUTION: LOOSE WELDING WIRE can cause injury.

- Keep firm hold on wire during installation, removal, and threading operations.

Spooled wire has a tendency to unravel rapidly when loosened from the spool.

Check the hub tension by slowly pulling the wire toward the drive roll. The wire should unwind freely, but have sufficient tension to keep the wire taut and prevent backlash when wire feeding stops. If adjustment is necessary, loosen or tighten the hub tension adjustment nut on the end of the spindle support shaft.



Ref. TA-121 446-B

Figure 4-4. Welding Wire Installation

4-7. SHIELDING GAS INSTALLATION (Figure 4-5)



WARNING: PRESSURIZED CYLINDERS can rupture causing serious personal injury and loss of life; **FALLING CYLINDERS** can cause serious injury and equipment damage.

- Keep cylinders away from any welding or other electrical circuits.
- Never allow a welding electrode to touch any cylinder.
- Always fasten cylinder securely to running gear bracket, a wall, or other stationary support.

A. Gas Cylinder (Customer Supplied) (Figure 4-5)

Chain the cylinder to a wall or other stationary support to prevent the cylinder from falling over and breaking off the valve. If optional running gear is used, secure gas cylinder to running gear with supplied chain.

B. Regulator/Flowmeter (Customer Supplied) (Figure 4-5)

1. With the cylinder securely installed, remove the cylinder cap, stand to one side of cylinder valve,

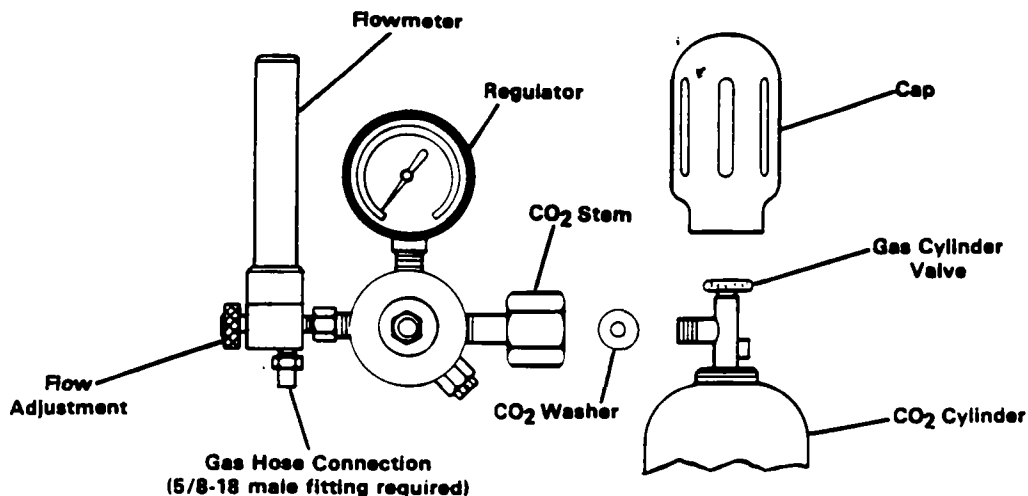
and open valve slightly. When gas flows from cylinder, close valve. This procedure blows out dust or dirt that may have accumulated around the valve seat.

2. The regulator/flowmeter must be properly equipped with a stem, nut connectors, and gasket for use with either CO₂ cylinders or inert gas type cylinders.

IMPORTANT: A gasket should be installed to prevent leaks. Do not use lubricants or sealing agents.

3. Install gas regulator/flowmeter onto gas cylinder valve; keep the face of the regulator/flowmeter gauge in vertical position, and tighten stem nut securely to gas cylinder valve.
4. A shielding gas output fitting is provided at the rear of the welding power source for making gas connections. Attach one end of the gas hose to this output fitting. Attach other end of the gas hose to the regulator/flowmeter.

CO₂ Installation



Argon Installation

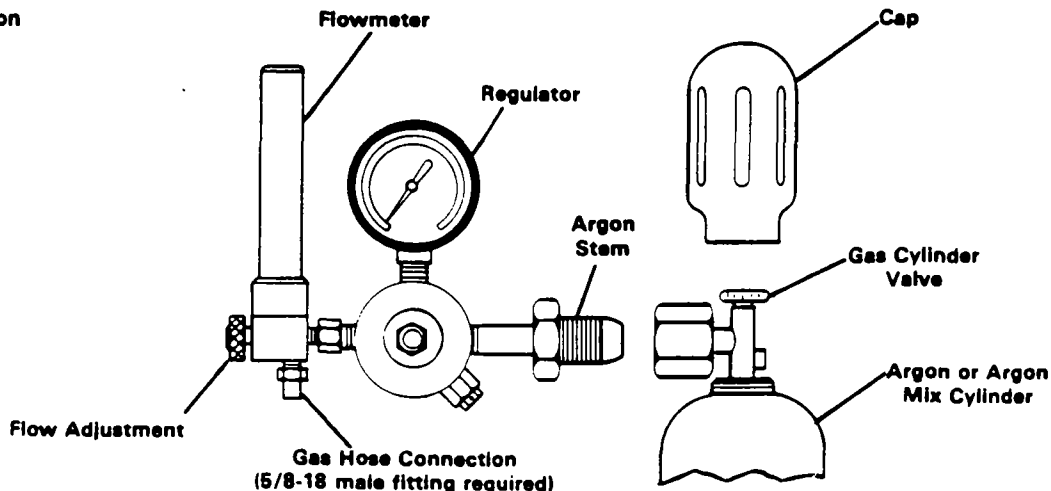


Figure 4-5. Typical Regulator/Flowmeter Installation

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4-8. CONNECT TO POWER

IMPORTANT: *This welder must be connected as follows:*

For 70 Ampere Models – Connect to a 15 ampere individual branch circuit or to a 20 ampere branch circuit.

For 90 Ampere Models – Connect to a 20 ampere individual branch circuit.

Be sure that the building supply wiring and receptacle meet these requirements and also comply with all national, state, and local electrical codes. Poor unit performance or frequently opening line fuses or circuit breakers can result from an inadequate or incorrect supply.

Table 4-1. Maximum Allowable Extension Cord Lengths (Based on a maximum 2% voltage drop)

Size AWG	#14*	#12	#10
Max. Length (ft.)	60	75	150

*For 70 Ampere Models only

An input power cord with plug is attached to the welder. Connect the plug to a properly grounded receptacle that is protected by time-delay fuses or a proper circuit breaker that meets all the requirements of the previous IMPORTANT block. Be sure that the building supply wiring and receptacle comply with all applicable codes.

If it is necessary to use an extension cord, be sure that the cord is of adequate size and capacity. See Table 4-1 for recommended extension cord sizes.

4-9. FEED THE WIRE



CAUTION: WELDING WIRE can cause puncture wounds; HOT SURFACES can burn skin.

- *Do not activate gun trigger until instructed to do so.*
- *Do not point gun toward any part of the body, other personnel, or any conductive surface when threading welding wire.*
- *Allow gun to cool before touching.*

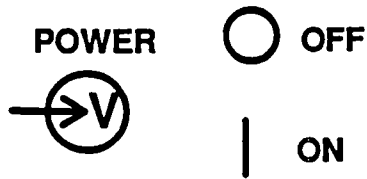
IMPORTANT: *Whenever removing or replacing the gun nozzle, twist it in a clockwise direction to avoid damage to the internal spring.*

1. Be sure the welding gun and wire are installed according to Sections 4-4 and 4-5.
2. Lay the gun cable assembly out as straight and as flat as possible.
3. Remove the nozzle and contact tube.
4. Turn ON the welder.
5. Depress and hold the gun trigger until the wire feeds approximately 1/2 in. (12 mm) from the end of the gun nozzle. Cut off any excess wire.
6. Turn OFF the welder.
7. Replace the contact tube and nozzle.
8. If necessary, readjust the hub tension according to Section 4-6.
9. Close and secure the left side access door.

IMPORTANT: *For a smoother weld start, be sure welding wire extends 1/2 in. (12 mm) beyond the end of the contact tube and that the wire has a sharp end.*

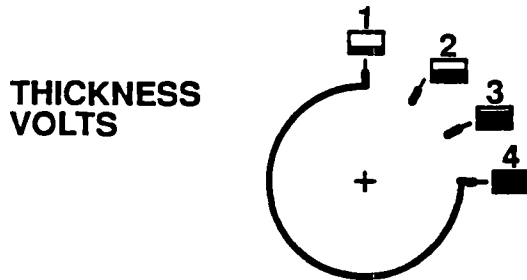
SECTION 5 – OPERATOR CONTROLS

5-1. POWER SWITCH (Figure 5-1)



Placing the POWER switch in the ON position energizes the welder and activates the cooling fan motor. Placing the POWER switch in the OFF position shuts down the welder.

5-2. THICKNESS/VOLTS SWITCH (Figure 5-1)



CAUTION: ARCING can damage contact surfaces.

- Do not change position of THICKNESS/VOLTS switch while welding or under load.

Arching causes the contacts to become pitted and eventually inoperative.

The THICKNESS/VOLTS switch provides voltage settings for four different ranges of metal thickness. These settings also determine the base wire feed speed for the thickness of the metal. The settings for the 70 Ampere/90 Ampere models are:

Setting 1 – Very Thin (19.6/20.8 Volts DC)

Setting 2 – Thin (22.4/23.0 Volts DC)

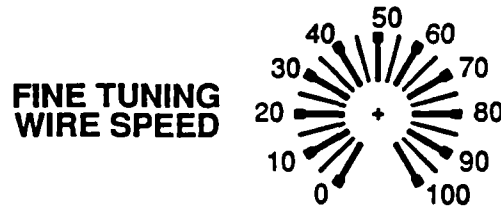
Setting 3 – Thicker (25.4/25.9 Volts DC)

Setting 4 – Thickest (28.5/28.4 Volts DC)

The higher the number selected, the thicker the material that can be welded.

IMPORTANT: The welder is designed for use with metals that are a maximum of 3/16 in. (4.8 mm) thick. Use with thicker metals will produce unsatisfactory results. Metals as thin as 22 or 24 gauge may be satisfactorily welded by experienced users.

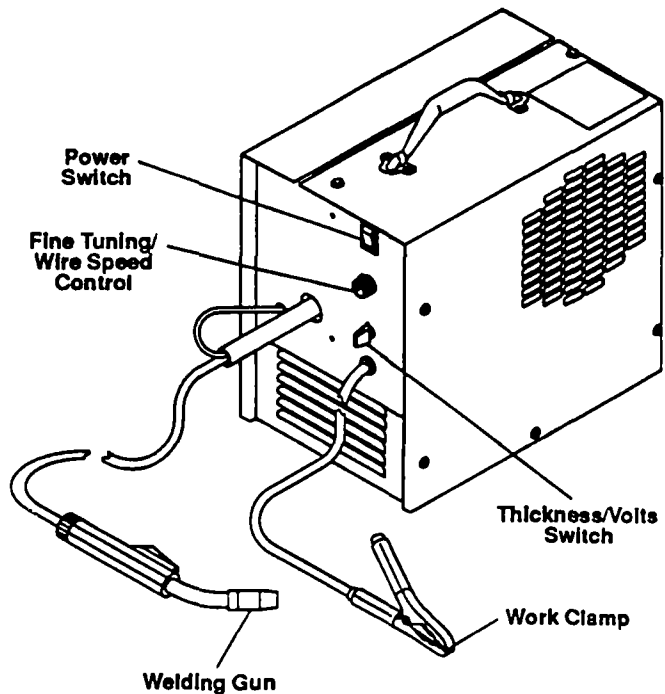
5-3. FINE TUNING/WIRE SPEED CONTROL (Figure 5-1)



IMPORTANT: The FINE TUNING/WIRE SPEED control may be adjusted while welding.

The FINE TUNING/WIRE SPEED control provides fine tuning of the speed that the wire feeds into the weld. The wire feed range is 28 to 163 inches per minute (0.7 to 4.1 meters per minute), when set by the THICKNESS/VOLTS switch and fine tuned by the FINE TUNING/WIRE SPEED control.

Rotate the knob clockwise to increase the wire feed speed. The numbers around the FINE TUNING/WIRE SPEED dial are for use as a reference when making settings, and do not indicate actual wire feed speed.



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Figure 5-1. Operator Controls

SECTION 6 – OPERATION



WARNING: ELECTRIC SHOCK can kill; **MOVING PARTS** can cause serious injury; **IMPROPER AIRFLOW AND EXPOSURE TO ENVIRONMENT** can damage internal parts.

- Do not touch live electrical parts.
- Keep away from moving parts.
- Keep all covers and panels in place while operating.

Warranty is void if the wire feeder is operated with any portion of the outer enclosure removed.

ARC RAYS, SPARKS, AND HOT SURFACES can burn eyes and skin; **NOISE** can damage hearing.

- Wear correct eye, ear, and body protection.

FUMES AND GASES can seriously harm your health.

- Keep your head out of the fumes.
- Ventilate to keep from breathing fumes and gases.
- If ventilation is inadequate, use approved breathing device.

WELDING WIRE can cause puncture wounds.

- Do not point gun toward any part of the body, any conductive surface, or other personnel.

HOT METAL, SPATTER, AND SLAG can cause fire and burns.

- Watch for fire.
- Keep a fire extinguisher nearby, and know how to use it.
- Do not use near flammable material.
- Allow work and equipment to cool before handling.

MAGNETIC FIELDS FROM HIGH CURRENTS can affect pacemaker operation.

- Wearers should consult their doctor before going near arc welding, gouging, or spot welding operations.

See Section 1 - Safety Rules For Operation Of Arc Welding Power Source for basic welding safety information.

6-1. GAS METAL ARC WELDING (GMAW)



WARNING: Read and follow safety information at beginning of entire Section 6 before proceeding.

1. Install and connect unit according to Section 4.
2. Wear dry insulating gloves and clothing.
3. Thoroughly clean joint area of the base metal with sandpaper or wire brush.



CAUTION: WELDING CURRENT can damage vehicle computers and other electronic components.

- Disconnect both battery cables before welding on a vehicle.
- Place work clamp as close to the weld as possible to avoid long electrical paths.
- Be sure gun to power source as well as cable connections to work clamp are clean and tight.
- To minimize risk, disconnect the computer(s) from the vehicle.

4. Open left side access door, and make sure that polarity changeover jumper links on polarity changeover board are in desired position (see Section 4-3).
5. Close regulator/flowmeter flow adjustment knob, and slowly open the gas cylinder valve.
6. Connect the work clamp to workpiece as close to the weld area as possible.
7. Set a voltage condition using the THICKNESS/VOLTS switch and the FINE TUNING/WIRE SPEED control appropriate for the base metal thickness and type of shielding gas being used (see Tables 6-1 and 6-2).
8. Purge shielding gas line as follows:



WARNING: ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Keep the welding wire isolated from the work clamp or any conductive surface when not welding.

The welding wire is electrically energized whenever the gun trigger is depressed. The difference in potential between the welding wire and the work clamp (or workpiece or table if the work clamp is connected to either) will cause current to flow if contact is made.

- a. Place Line Disconnect switch in the ON position.
- b. Place POWER switch on the welding power source in the ON position.
- c. Release drive roll pressure. Depress gun trigger for approximately 15 seconds to allow for adjustment of regulator/flowmeter and to purge gas hose of air.

IMPORTANT: Gas pressure of 6 pounds or flow rate of 15 cfh are typical. Welding out of position at high wire feed speeds, or welding in a drafty environment will require more shielding gas.

- d. Place POWER switch on welding power source in OFF position, and retighten drive roll pressure according to Section 7-4.
9. Wear welding helmet fitted with a #10 lens.

10. Place POWER switch on welding power source in ON position, and begin welding.
11. Adjust FINE TUNING/WIRE SPEED control as necessary.

6-2. FLUX CORED ARC WELDING (FCAW)



WARNING: Read and follow safety information at beginning of entire Section 6 before proceeding.

1. Install and connect the unit according to Section 4.
2. Wear dry insulating gloves and clothing.
3. Thoroughly prepare the joint area by cleaning the base metal with sandpaper or a wire brush.
4. Open the left side access door, and make sure that the polarity jumper links are in the desired position for the wire being used (Section 4-3).
5. Close and secure the access door.
6. Connect the work clamp to a clean, paint-free location on the workpiece, as close to the weld area as possible.
7. Set the THICKNESS/VOLTS switch and the FINE TUNING/WIRE SPEED control to the desired positions for the base metal thickness and type of

shielding gas, if applicable, being used (see Tables 6-1 and 6-2).



WARNING: ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Keep the welding wire isolated from the work clamp or any other conductive surface when not welding.

The welding wire is electrically energized whenever the gun trigger is depressed. The difference in potential between the welding wire and the work clamp (or workpiece or table if the work clamp is connected to either) will cause current to flow if contact is made.

8. Wear welding helmet fitted with a #10 lens.
9. Turn ON the welder, and begin welding.
10. Fine tune the FINE TUNING/WIRE SPEED control as necessary.

6-3. SHUTTING DOWN

1. Stop welding.
2. Turn OFF the welder.
3. Close gas cylinder valve, if applicable.



WARNING: HIGH CONCENTRATION OF SHIELDING GAS can harm health or kill.

- Shut off gas supply when not in use.

Table 6-1. Suggested Welding Settings For 70 Ampere Models

GMAW And FCAW

Shielding Gas	Wire Diameter (inch)	Operator Control Settings	Material Thickness				
			12 ga. and Thicker	14-13 ga.	17-15 ga.	20-18 ga.	Thinner Than 20 ga.
Solid Steel CO ₂	0.023-0.025	Range	—	3-4	3	2	1
		Feed Speed*	—	100	95	70	55
E-71T-GS	.030	Range	4	3	2	1	1
		Feed Speed*	90	50	50	60	30
	.035	Range	4	3	2	1	1
		Feed Speed*	60	40	40	50	25

*Adjust FINE TUNING/WIRE SPEED control as required.

+cfh = cubic feet per hour

IMPORTANT: If in doubt, set THICKNESS/VOLTS switch for voltage desired and set FINE TUNING/WIRE SPEED to 50. The weld can be started and fine tuned during operation. If input voltage is low, a higher THICKNESS/VOLTS setting may be required to obtain desired weld.

Table 6-2. Suggested Welding Settings For 90 Ampere Models
GMAW And FCAW

Shielding Gas And Flow Rate	Wire Diameter (inch)	Operator Control Settings	Material Thickness						
			1/8 in. (3.2 mm)	12 ga.	14 ga.	16 ga.	18 ga.	22 ga.	24 ga.
E70S-6 Mild Steel CO ₂ 20 cfh	.023	Range	4	4	3	2	2	1	1
		Feed Speed*	50	50	50	45	40	30	30
	.030	Range	4	4	3	3	2	1	1
		Feed Speed*	40	40	40	40	40	40	35
	.035	Range	—	—	—	—	—	—	—
		Feed Speed*	—	—	—	—	—	—	—
E70S-6 Mild Steel 75% Argon 25% CO ₂ 20cfh	.023	Range	4	4	3	2	2	1	1
		Feed Speed*	60	55	50	45	40	35	35
	.030	Range	4	4	3	3	2	1	1
		Feed Speed*	50	50	50	50	45	45	40
E-71T-GS	.030	Range	4	3	3	1	1	1	—
		Feed Speed*	30	30	20	25	20	20	—
	.035	Range	4	3	2	1	1	1	—
		Feed Speed*	30	25	25	25	25	20	—
ER 308 Stainless Steel Tri-Mix 20 cfh	.023	Range	4	4	4	3	3	2	—
		Feed Speed*	40	35	35	30	30	20	—
	.030	Range	4	4	4	3	3	2	—
		Feed Speed*	30	30	30	25	20	15	—
	.035	Range	4	4	4	3	2	—	—
		Feed Speed*	15	15	15	15	15	—	—
Aluminum Argon 20 cfh	.030	Range	—	4	3	2	1	—	—
		Feed Speed*	—	85	80	75	70	—	—
	.035	Range	—	4	4	2	2	—	—
		Feed Speed*	—	55	60	60	55	—	—

*Adjust FINE TUNING/WIRE SPEED control as required.

+cfh = cubic feet per hour

IMPORTANT: If in doubt, set THICKNESS/VOLTS switch for voltage desired and set FINE TUNING/WIRE SPEED to 50. The weld can be started and fine tuned during operation. If input voltage is low, a higher THICKNESS/VOLTS setting may be required to obtain desired weld.

SECTION 7 – MAINTENANCE & TROUBLESHOOTING

7-1. ROUTINE MAINTENANCE (Table 7-1)

IMPORTANT: *Every six months inspect the labels on this unit for legibility. All precautionary labels must be maintained in a clearly readable state and replaced when necessary. See Parts List for part number of precautionary labels.*



WARNING: ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Turn OFF welder, and remove input power plug from receptacle before inspecting, maintaining, or servicing.

MOVING PARTS can cause serious injury.

- Keep away from moving parts.

HOT SURFACES can cause severe burns.

- Allow cooling period before servicing.

Maintenance to be performed only by qualified persons.

Table 7-1. Maintenance Schedule

Frequency*	Maintenance
Every month.	Units in heavy service environments: Check labels, weld cables, clean internal parts.
Every 3 months.	Check weld cables (see Section 7-1B).
Every 6 months.	Check all labels (see IMPORTANT block, Section 7-1). Clean internal parts (see Section 7-1C).

*Frequency of service is based on units operated 40 hours per week. Increase frequency of maintenance if usage exceeds 40 hours per week.

A. Fan Motor

This unit is equipped with an exhaust fan and relies on forced draft for adequate cooling. The fan motor is manufactured with lifetime sealed bearings and requires no maintenance.

B. Weld Cables



WARNING: Read and follow safety information at beginning of entire Section 7-1 before proceeding.

Every three months inspect cables for breaks in insulation. Repair or replace cables if insulation breaks are present. Clean and tighten connections at each inspection.

C. Internal Cleaning



WARNING: Read and follow safety information at beginning of entire Section 7-1 before proceeding.

Every six months blow out or vacuum dust and dirt from the inside of the welding power source. Remove the outer enclosure, and use a clean, dry airstream or vacuum suction for the cleaning operation. If dusty or dirty conditions are present, clean the unit monthly.

7-2. DRIVE ROLL CLEANING (Figure 7-1)

IMPORTANT: *Failure to properly maintain the drive rolls can result in a buildup of wire particles which will decrease the efficiency of the wire feeding operation.*

Every time welding wire is installed or changed, inspect the wire groove on the drive roll for buildup of wire particles. If buildup is present, remove the drive roll for cleaning.

1. Turn OFF the welder.
2. Open the left side access door.
3. Loosen the drive roll pressure adjustment knob, pivot the pressure adjustment arm down, away from the cover. Pivot the pressure roll assembly up until it is in the open position. See Figure 4-4.
4. Loosen the drive roll setscrews.
5. Remove the drive roll from the shaft.
6. Use a wire brush to clean both drive roll grooves.
7. Slide the drive roll onto the motor shaft so the desired wire groove (knurled for flux cored wire, smooth for hard wire) is toward the inside of the machine. Push the drive roll back until the desired groove aligns with the inlet and outlet guides.
8. Tighten the drive roll setscrews making sure that one is centered on the flat of the motor shaft.
9. Reinstall the wire spool according to Section 4-5.
10. Close and secure the side access door.

7-3. WELDING GUN INSPECTION AND MAINTENANCE

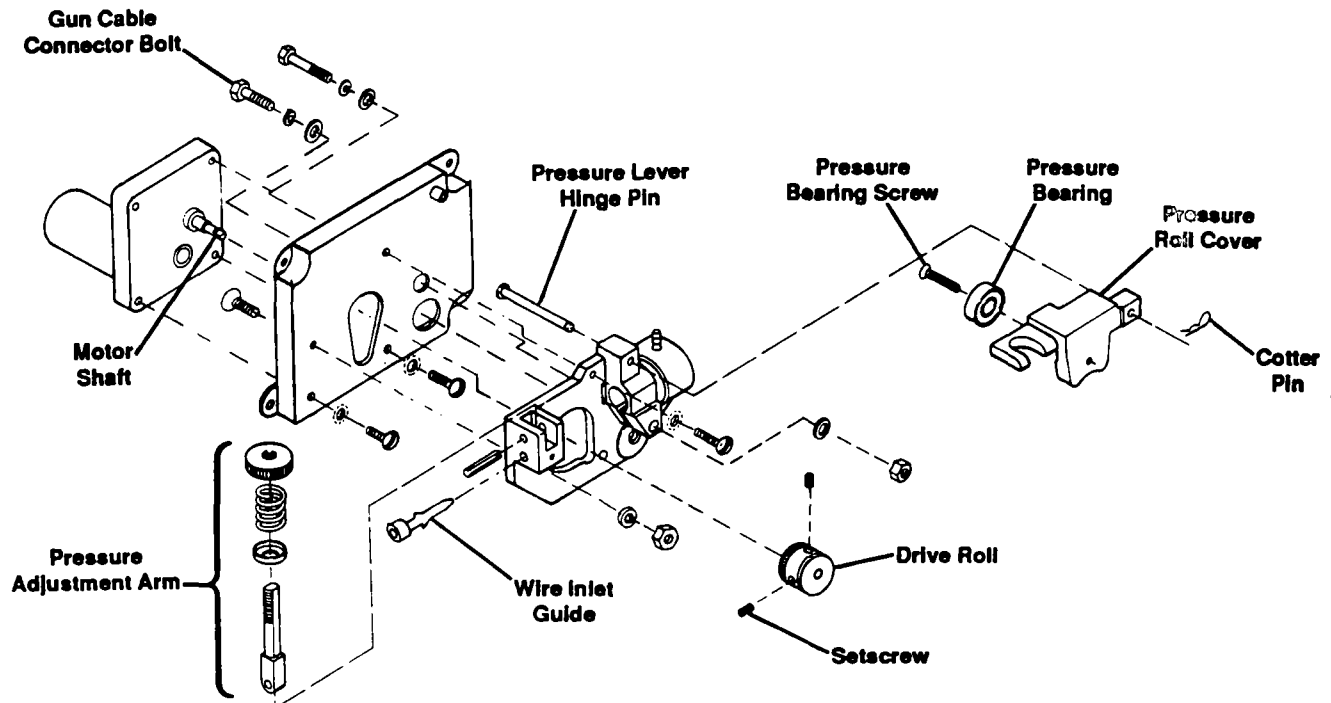


WARNING: HOT SURFACES can cause severe burns.

- Allow equipment to cool before handling.

The amount of usage and shop conditions will determine the frequency of this type of maintenance.

1. Turn OFF and unplug the welder.
2. Inspect the gun for broken areas, cracks and loose parts. Tighten, repair, and replace components as required.



TC-121 448-A

Figure 7-1. Wire Drive Assembly And Replacement

3. Carefully clean any weld spatter or dirt from around the nozzle opening.
4. Inspect the cables for frayed or cracked insulation. Repair or replace all frayed or cracked cables.
5. Remove grease and dirt from all components. Dry electrical parts and cables.



CAUTION: FLYING DIRT AND METAL CHIPS can injure personnel and damage equipment.

• Point gun liner only in a safe direction away from personnel and equipment when cleaning with compressed air.

IMPORTANT: Whenever removing or replacing the gun nozzle, twist it in a clockwise direction to avoid damage to the internal spring.

6. Remove the nozzle and contact tube.
7. Blow out gun casing or liner with compressed air whenever the wire or liner is removed.

7-4. REPLACING THE DRIVE ROLL (Figure 7-1)

1. Turn OFF and unplug the welder.
2. Open the left side access door.
3. Loosen the drive roll pressure adjustment knob, pivot the pressure adjustment arm down, away from the cover. Pivot the pressure roll assembly up until it is in the open position.
4. Loosen the drive roll setscrews.

5. Remove the drive roll from the shaft.
6. Slide the new drive roll onto the motor shaft so the desired wire groove (knurled for flux cored wire, smooth for hard wire) is to the inside of the machine. Push the drive roll back until the desired groove aligns with the inlet and outlet guides.
7. Tighten the drive roll setscrews making sure that one is centered on the flat portion of the motor shaft.
8. Close and secure the side access door.

7-5. REPLACING THE PRESSURE BEARING (Figure 7-1)

1. Turn OFF and unplug the welder.
2. Open the left side access door.
3. Loosen the pressure adjustment knob, pivot the pressure adjustment arm down, away from the cover. Pivot the pressure roll assembly up until it is in the open position.
4. Remove the cotter pin from the pressure lever hinge pin.
5. Remove the pressure lever assembly from the hinge pin.
6. Remove the securing screw from the pressure bearing. Remove the pressure bearing from the pressure lever assembly.
7. Install the new pressure bearing and reinstall the securing screw.
8. Reinstall the pressure lever assembly onto the hinge pin.

9. Reinstall the cotter pin onto the end of the hinge pin.
10. Make sure the wire is riding in the drive roll groove. Pivot the pressure roll assembly down onto the drive roll.
11. Pivot the pressure adjustment arm up until it seats on top of the pressure roll assembly.
12. Turn the pressure adjustment knob clockwise until the drive roll assembly is secure. Adjust the drive roll pressure just enough to prevent the wire from slipping on or against the drive roll during operation.
13. Close and secure the access door.

7-6. REPLACING THE WIRE INLET GUIDE (Figure 7-1)



WARNING: HOT SURFACES can cause severe burns.

- Allow equipment to cool before handling.

1. Turn OFF and unplug the welder.
2. Open the left side access door.
3. Loosen the drive roll pressure adjustment knob, pivot the pressure adjustment arm down, away from the cover. Pivot the pressure roll assembly up until it is in the open position.



CAUTION: LOOSE WELDING WIRE can cause injury.

- Keep firm hold on wire during installation, removal, and threading operations.

Spooled wire has a tendency to unravel rapidly when loosened from the spool.

4. Cut the welding wire at the point where it enters the wire inlet guide. Pull the wire out through the nozzle end of the welding gun.
5. Remove and replace the inlet guide.

IMPORTANT: Wire guides should be installed so that the tip(s) of the guide is as close to the drive roll as possible without touching.

6. Thread the welding wire as instructed in Section 4-5.
7. Pivot the pressure adjustment arm up until it seats on top of the pressure roll assembly.
8. Turn the pressure adjustment knob clockwise until the drive roll assembly is secure. Adjust the drive roll pressure just enough to prevent the wire from slipping on or against the drive roll during operation.
9. Close and secure the access door.

7-7. SHORT CIRCUIT SHUTDOWN (90 Ampere Models Only)

The unit is protected from damage due to contact tube short by optical coupler OC1 on motor control circuit board PC1. If the contact tube is shorted to the workpiece while welding, the unit completely shuts down. To resume operation, release gun trigger, remove contact tube from workpiece, and continue welding.

7-8. CIRCUIT BOARD REPLACEMENT (90 Ampere Models Only) (Figure 7-2)

If circuit board PC1 is at fault for a problem with the unit, replace the board using the following procedure. Do not attempt board repair. Contact the nearest Factory Authorized Service Station for correct replacement part.



WARNING: ELECTRIC SHOCK can kill.

- Do not touch live electrical parts.
- Turn OFF welder, and remove input power plug from receptacle before handling.

HOT SURFACES can cause severe burns.

- Allow equipment to cool before handling.



CAUTION: ELECTROSTATIC DISCHARGE can damage circuit board components.

- Put on properly grounded wrist strap BEFORE handling circuit boards.
- Transport all static-sensitive components in proper static-shielding carriers or packages.
- Perform work only at a static-safe work area.

IMPORTANT: All directions, such as left or right, are with respect to the operator facing the unit front panel. Retain all hardware removed during this procedure for reinstallation unless specifically told otherwise.

1. Remove wrapper.



CAUTION: EXCESSIVE PRESSURE can break circuit board.

- Use only minimal pressure and gentle movement when disconnecting or connecting board plugs.

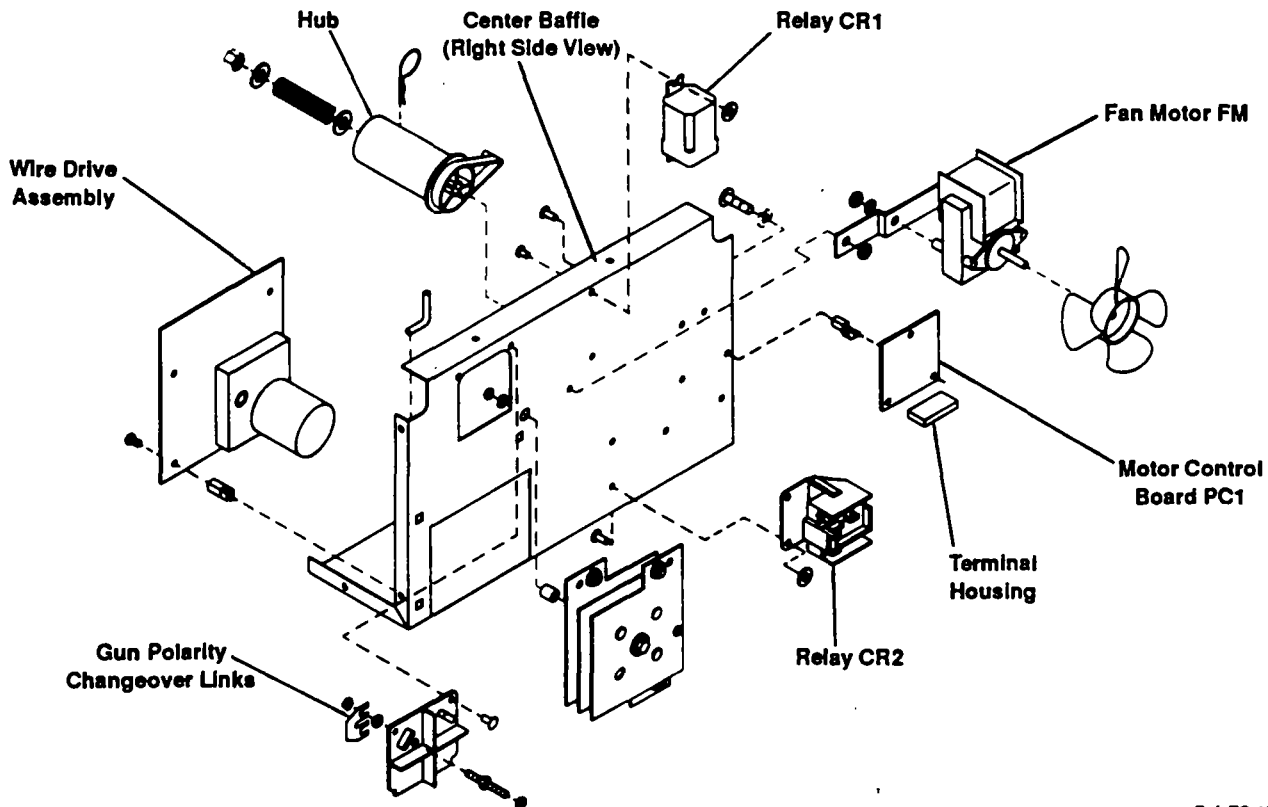
2. Remove terminal housing from terminal header RC1 on PC1.
3. Note board mounting position, release PC1 from support standoffs, and remove PC1 from center baffle in unit.
4. Install new PC1 onto center baffle, and reconnect terminal housing onto terminal header RC1 on new PC1. Be sure that all pins on RC1 mate with socket in terminal housing.



CAUTION: INCORRECT INSTALLATION or misaligned plugs can damage circuit board.

- Be sure that plugs are properly installed and aligned before reinstalling wrapper.

5. Reinstall wrapper onto unit.



Ref. TC-121 484

Figure 7-2. Motor Control Board PC1 Replacement

7-9. REPLACING THE CONTACT TUBE (Figure 7-3)



WARNING: HOT SURFACES can cause severe burns.

- Allow equipment to cool before handling.

IMPORTANT: Whenever removing or replacing the gun nozzle, twist it in a clockwise direction to avoid damage to the internal spring.

1. Turn OFF and unplug the welder.
2. Remove the nozzle.
3. Cut off any wire that extends beyond the end of the contact tube.
4. Remove contact tube and contact tube adapter (if applicable), and replace with new contact tube and adapter.
5. Replace the nozzle and resume operation.

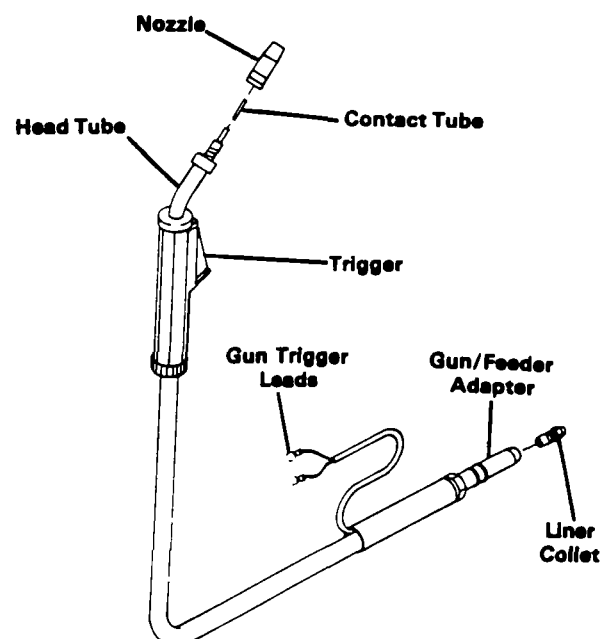
7-10. GUN WIRE AND LINER REPLACEMENT (Figure 7-3)



WARNING: HOT SURFACES can cause severe burns.

- Allow equipment to cool before handling.

IMPORTANT: Whenever removing or replacing the gun nozzle, twist it in a clockwise direction to avoid damage to the internal spring.



Ref. TB-121 447

Figure 7-3. Gun Parts Replacement

1. Turn OFF and unplug the welder.
2. Remove the nozzle.
3. Cut off any wire that extends beyond the end of the contact tube.
4. Remove the contact tube.



CAUTION: LOOSE WELDING WIRE can cause injury.

- *Keep firm hold on wire during installation, removal, and threading operations.*

Spooled wire has a tendency to unravel rapidly when loosened from the spool.

5. Retract the wire onto the spool.
6. Disconnect the gun cable from the welder.
7. Remove the liner collet.
8. Lay the cable assembly out flat and straight with no kinks or coils.
9. Pull the liner out through the adapter end of the gun assembly.



CAUTION: FLYING DIRT AND METAL CHIPS can injure personnel and damage equipment.

- *Point gun liner only in a safe direction away from personnel and equipment when cleaning with compressed air.*

10. Blow out the gun casing with compressed air.
11. Replace the contact tube.
12. Insert the new liner into the gun cable through the adapter end of the assembly. The liner should butt against the contact tube.
13. Install the collet onto the liner and into the adapter. The liner should still butt against the contact tube.
14. Cut off and smooth rough edges of the liner at the adapter end so the liner can be as close to the drive rolls as possible without touching when reinstalled in the welder.
15. Reinstall the gun cable into the wire drive assembly.
16. Thread the welding wire as instructed in Section 4-5.
17. Resume operation.

7-11. FUSE F1 (70 Ampere Models Only)



WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Turn OFF welder, and remove input power plug from receptacle before handling.*

IMPROPER FUSE can damage unit.

- *Be sure replacement fuse is same size, type, and rating (see Parts List).*

The wire drive motor MOT is protected from overload by fuse F1 located in the harness behind the right side panel.

To replace F1, proceed as follows:

1. Remove the welder cover.
2. Check F1, and replace if necessary.
3. Reinstall the cover.

7-12. THERMAL OVERLOAD PROTECTION

The welder is protected from overheating by thermostat TP1 located on the main transformer T1. This normally closed thermostat opens when overheating occurs, and shuts down the weld output. The fan continues to run and cools the unit.

Once the welder cools, the thermostat closes and restores weld output.

7-13. TROUBLESHOOTING (Table 7-2)



WARNING: ELECTRIC SHOCK can kill.

- *Do not touch live electrical parts.*
- *Turn OFF welder, and remove input power plug from receptacle before inspecting, maintaining, or servicing.*

MOVING PARTS can cause serious injury.

- *Keep away from moving parts.*

HOT SURFACES can cause severe burns.

- *Allow cooling period before servicing.*

Troubleshooting to be performed only by qualified persons.

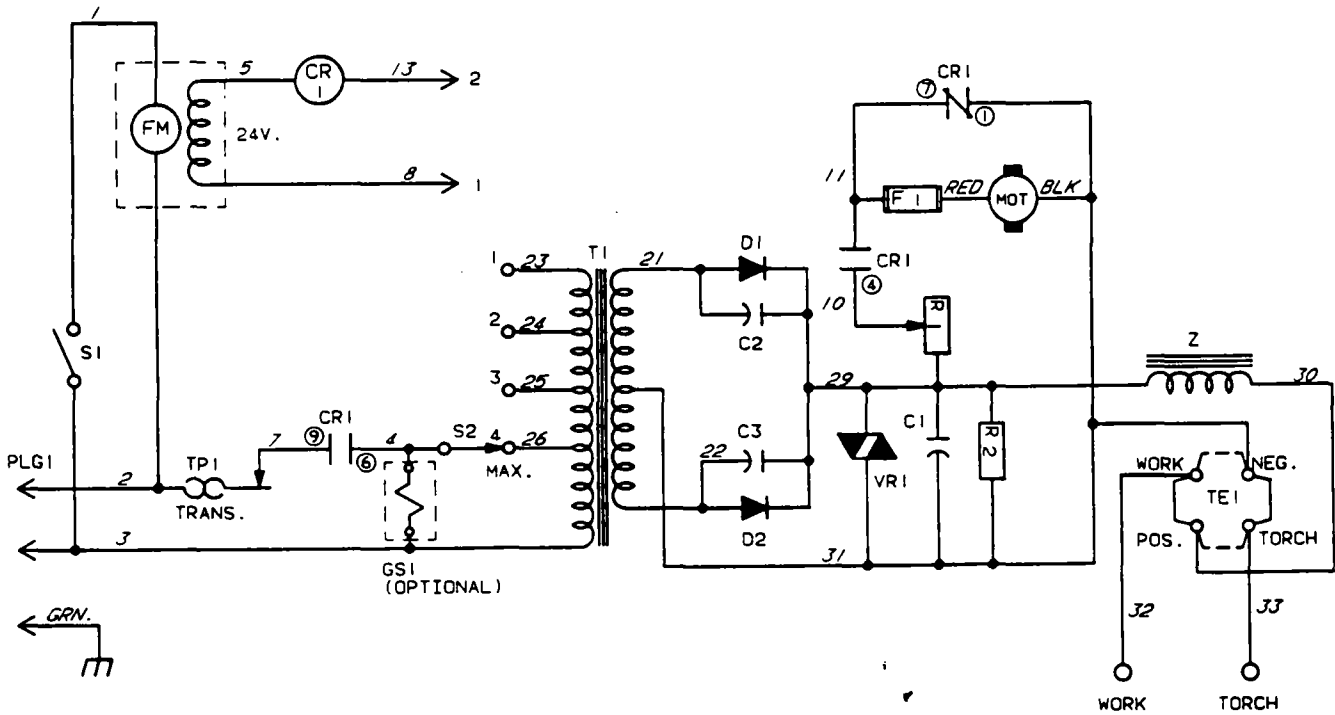
It is assumed that the unit was properly installed according to Section 4 of this manual, the operator is familiar with the function of controls, the welder was working properly, and that the trouble is not related to the welding process. The following table is designed to diagnose and provide remedies for some of the troubles that may develop in this welder.

Use this table in conjunction with the circuit diagram while performing troubleshooting procedures. If the trouble is not remedied after performing these procedures, the nearest Factory Authorized Service Station should be contacted. In all cases of equipment malfunction, the manufacturer's recommendations should be strictly followed.

Table 7-2. Troubleshooting

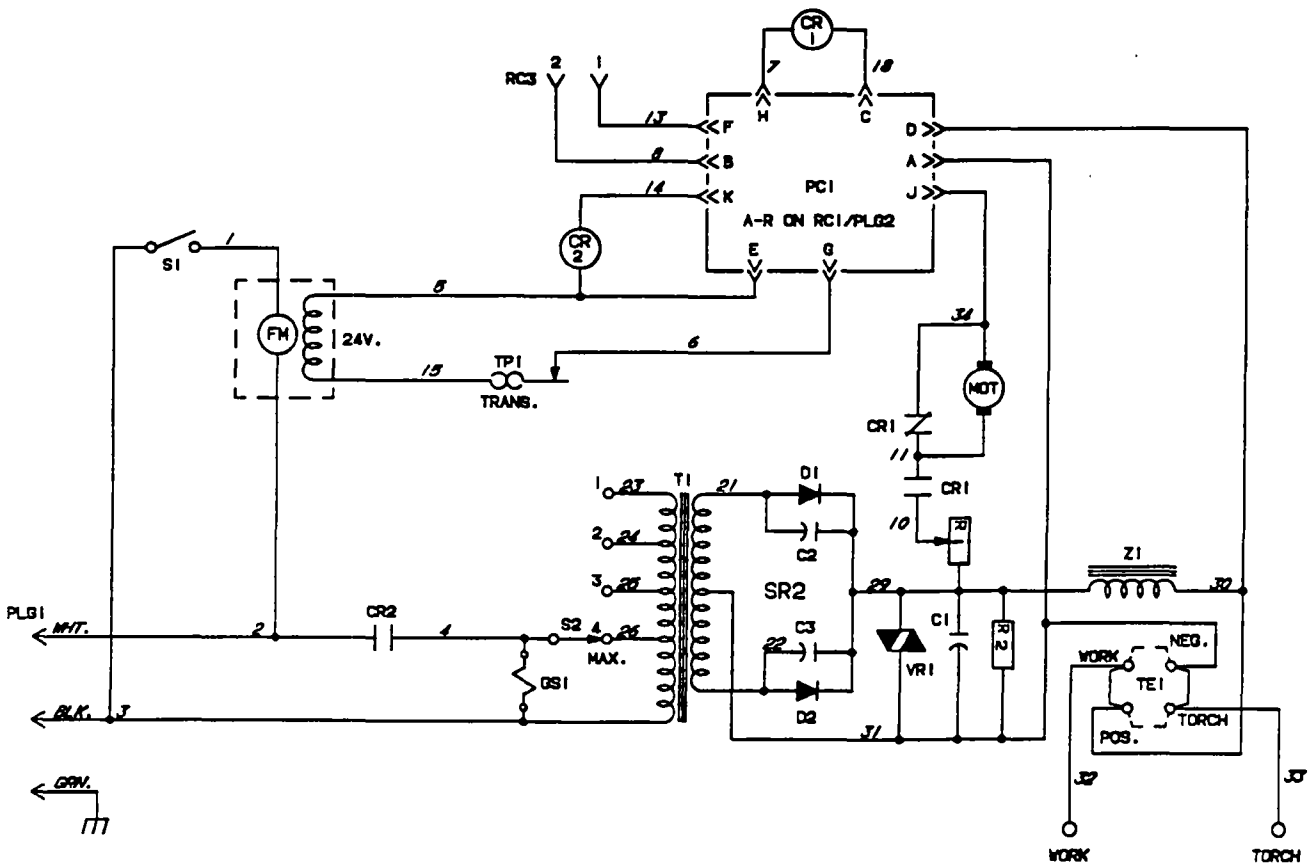
TROUBLE	PROBABLE CAUSE	REMEDY
No weld output; wire does not feed.	Power cord plug not secure in wall receptacle.	Secure plug in receptacle.
	Building line fuse or circuit breaker open.	Replace line fuse or reset circuit breaker.
	Fuse F1.	Check and replace F1 (see Section 7-12).
	Gun trigger connection leads not secure.	Secure gun trigger connector leads.
	Gun trigger, or gun trigger leads open.	Replace gun trigger (if applicable) or repair trigger leads.
	Power switch S1.	Replace S1.
	Switch control relay CR1.	Replace CR1.
No weld output; wire does not feed; fan motor continues to run.	Thermostat TP1 open (thermal shutdown).	Allow fan to run; the thermostat will close when the unit has cooled (see Section 7-12).
No weld output; wire feeds.	Work clamp connection loose or incomplete due to rust, paint, etc. on surface of workpiece.	Remake work connection ensuring good metal to metal contact.
	Contact tube.	Replace contact tube (see Section 7-9).
Low weld output.	Low input line power.	Connect unit to proper input voltage or check for low line voltage.
Electrode wire stops feeding while welding.	Sharp or excessive bend in gun cable or liner.	Straighten gun cable and/or replace liner (see Section 7-10).
	Incorrect drive roll pressure.	Adjust drive roll pressure (see Section 4-5).
	Wrong groove in place on drive roll.	Reverse to proper groove (see Section 7-4).
	Incorrect hub tension.	Readjust hub tension (see Section 4-6).
	Contact tube opening restricted; bumbuck of wire into tube.	Replace contact tube (see Section 7-9).
	Friction in gun.	Check wire passage; clean, replace parts as required (see Sections 7-9 and 7-10.)
	Gun casing liner dirty or plugged.	Clean or replace liner (see Section 7-10).
	Motor Drive Board PC1 (90 Ampere Models Only).	Replace PC1 according to Section 7-8.
	Broken or damaged casing or liner.	Replace damaged parts (see Section 7-10).
	Drive roll or pressure bearing worn or slipping.	Replace drive roll or pressure bearing as required (see Sections 7-4 and 7-5).
	Gun trigger switch or leads broken.	Replace switch; check leads and connections.
	Excessive loading of drive motor.	Clear restriction in drive assembly.
	Drive motor.	Contact nearest Factory Authorized Service Station.

SECTION 8 – ELECTRICAL DIAGRAMS



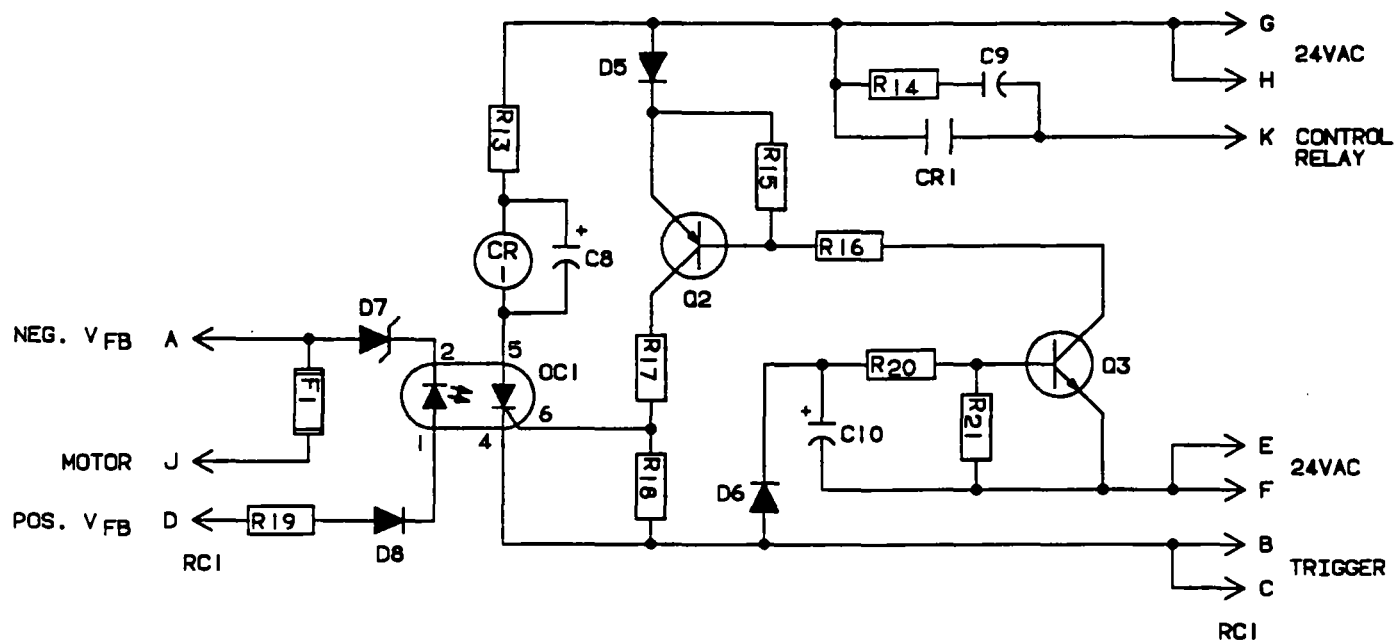
Circuit Diagram No. A-120 666-A

Diagram 8-1. Circuit Diagram For 70 Ampere Models



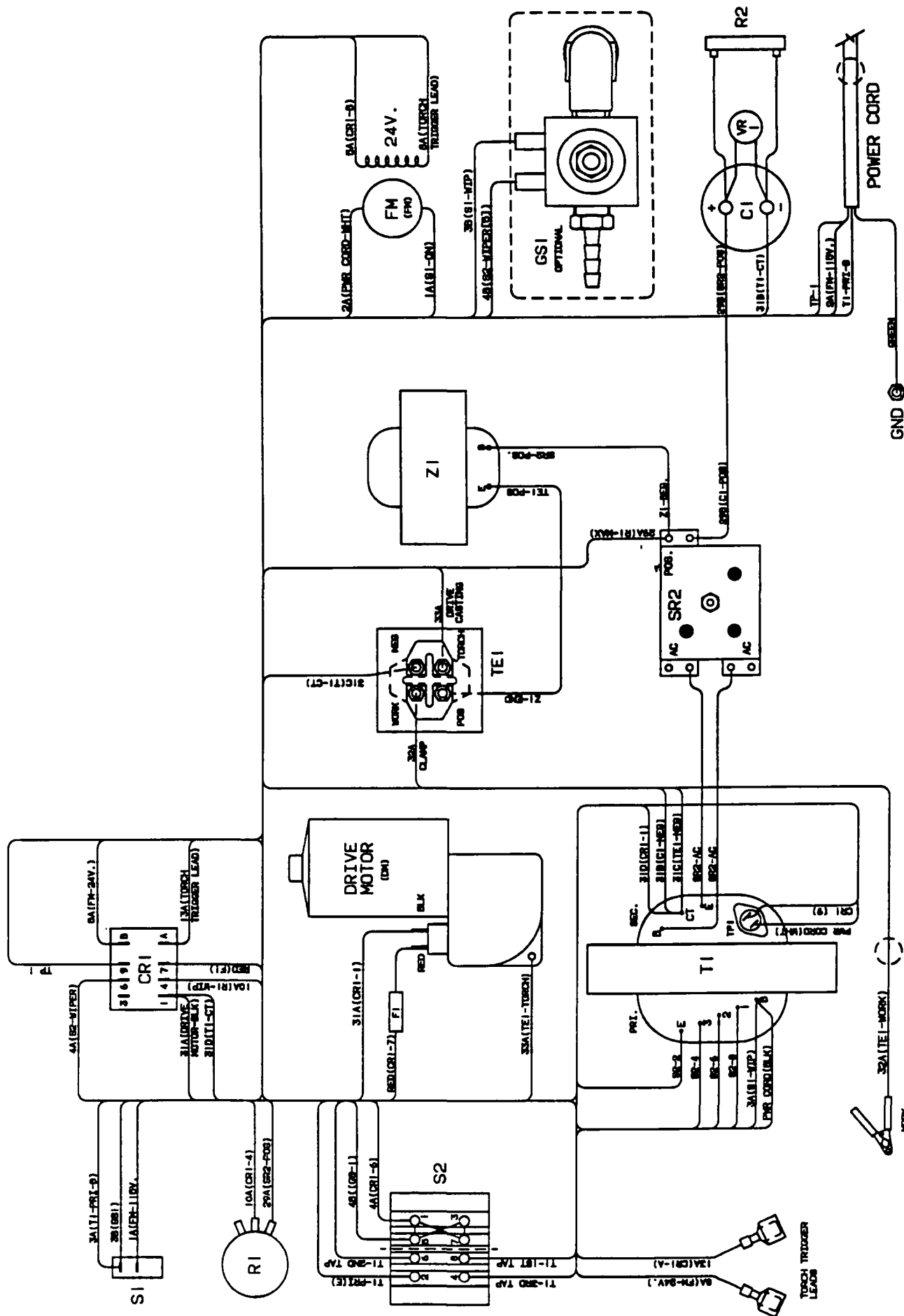
Circuit Diagram No. SB-124 441-A

Diagram 8-2. Circuit Diagram For 90 Ampere Models



Circuit Diagram No. SB-124 474

Diagram 8-3. Circuit Diagram For 90 Ampere Model Short Circuit And Burnback Control Board PC1



Wiring Diagram No. SC-119 811-B

Diagram 8-4. Wiring Diagram For 70 Ampere Models

SECTION 9 – PROJECT INSTRUCTIONS

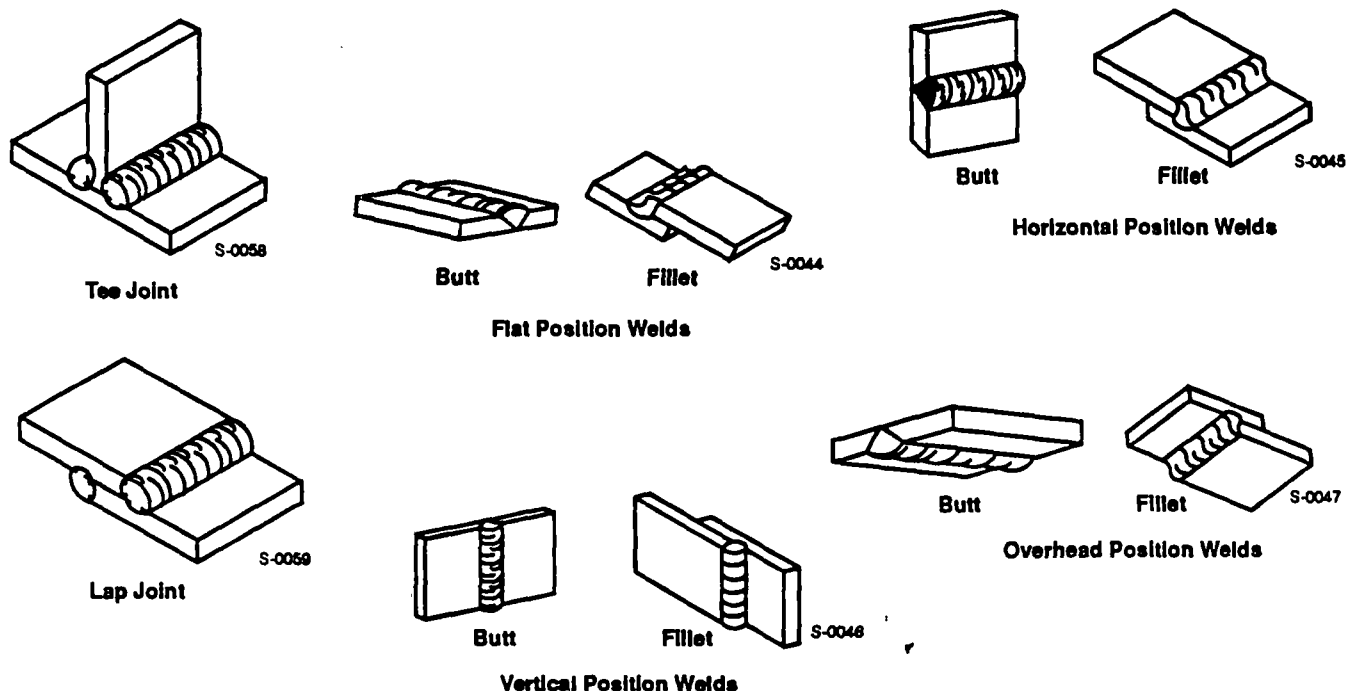


Figure 9-1. Basic Weld Joints



WARNING: ELECTRIC SHOCK can kill; MOVING PARTS can cause serious injury; IMPROPER AIRFLOW AND EXPOSURE TO ENVIRONMENT can damage internal parts.

- Do not touch live electrical parts.
- Keep away from moving parts.
- Keep all covers and panels in place while operating.

Warranty is void if the wire feeder is operated with any portion of the outer enclosure removed.

ARC RAYS, SPARKS, AND HOT SURFACES can burn eyes and skin; **NOISE** can damage hearing.

- Wear correct eye, ear, and body protection.

FUMES AND GASES can seriously harm your health.

- Keep your head out of the fumes.
- Ventilate to keep from breathing fumes and gases.
- If ventilation is inadequate, use approved breathing device.

WELDING WIRE can cause puncture wounds.

- Do not point gun toward any part of the body, any conductive surface, or other personnel.

HOT METAL, SPATTER, AND SLAG can cause fire and burns.

- Watch for fire.
- Keep a fire extinguisher nearby, and know how to use it.
- Do not use near flammable material.
- Allow work and equipment to cool before handling.

MAGNETIC FIELDS FROM HIGH CURRENTS can affect pacemaker operation.

- Wearers should consult their doctor before going near arc welding, gouging, or spot welding operations.

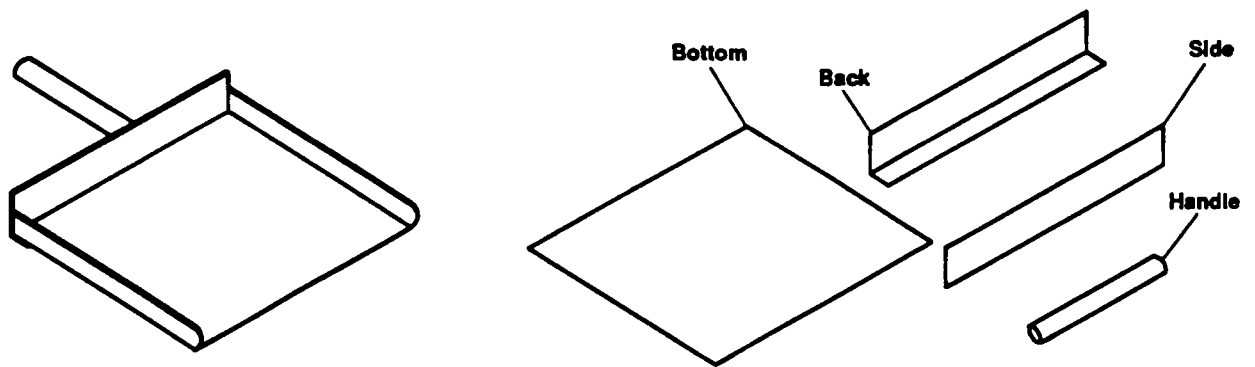
See Section 1 - Safety Rules For Operation Of Arc Welding Power Source for basic welding safety information.

9-1. OVERVIEW

The following instructions are for projects that you can construct using your new welder. These projects can be easily completed after you have had some practice welding. They can be constructed of mild steel scrap metal. Examine dimensions before you start. Most dimensions can be tailored to fit your exact needs.

Some of the basic weld joints are illustrated in Figure 9-1. Use these joints when constructing the projects.

9-2. DUST PAN



S-0210

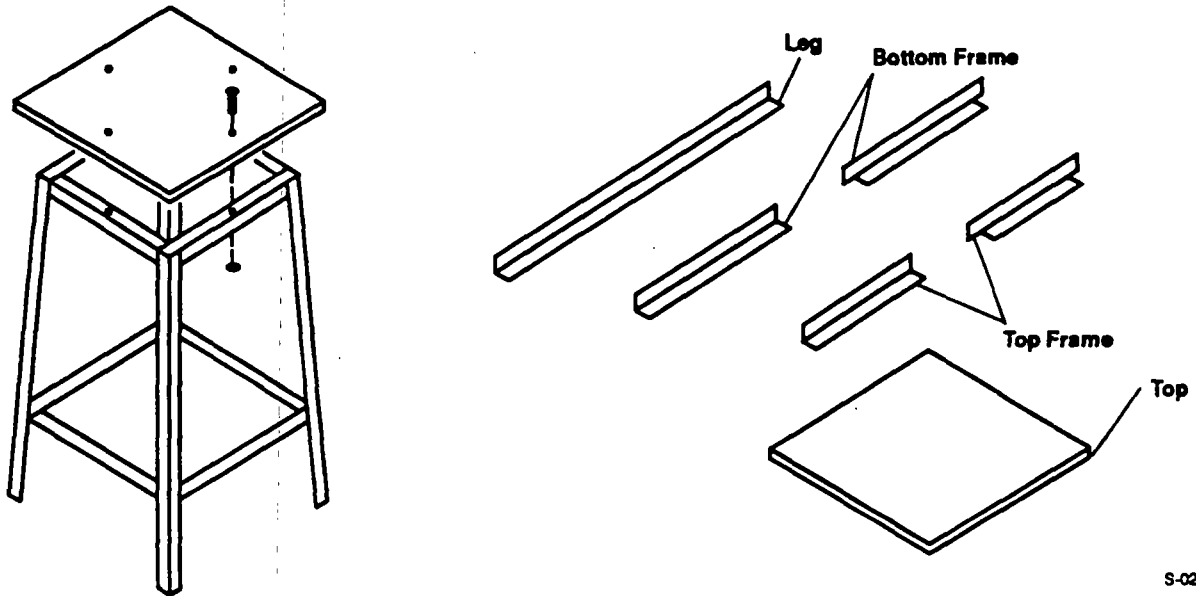
Figure 9-2. Material For Dust Pan

Table 9-1. Dust Pan Material List

Part	# Req'd	Size	Description
Bottom	1	8 x 9 in. (203.2 x 228.6 mm)	Sheet Metal
Back	1	9 in. (228.6 mm)	1 x 1-1/2 in. (25.4 x 38.1 mm) Angle Iron
Side	2	8 x 1 in. (203.2 x 25.4 mm)	Sheet Metal
Handle	1	6 in. (152.4 mm)	5/8 in. (15.9 mm) Pipe

1. Cut materials according to the material list, Table 9-1, and Figure 9-2. Smooth sharp edges.
2. Drill hole for hanging 1/2 in. (12.7 mm) from one end of handle.
3. Weld 1 in. (25.4 mm) side of back to 9 in. (228.6 mm) side of bottom.
4. Weld sides to 8 in. (203.2 mm) sides of bottom.
5. Weld end of handle without hole to center of back.

9-3. SHOP STOOL



S-0211

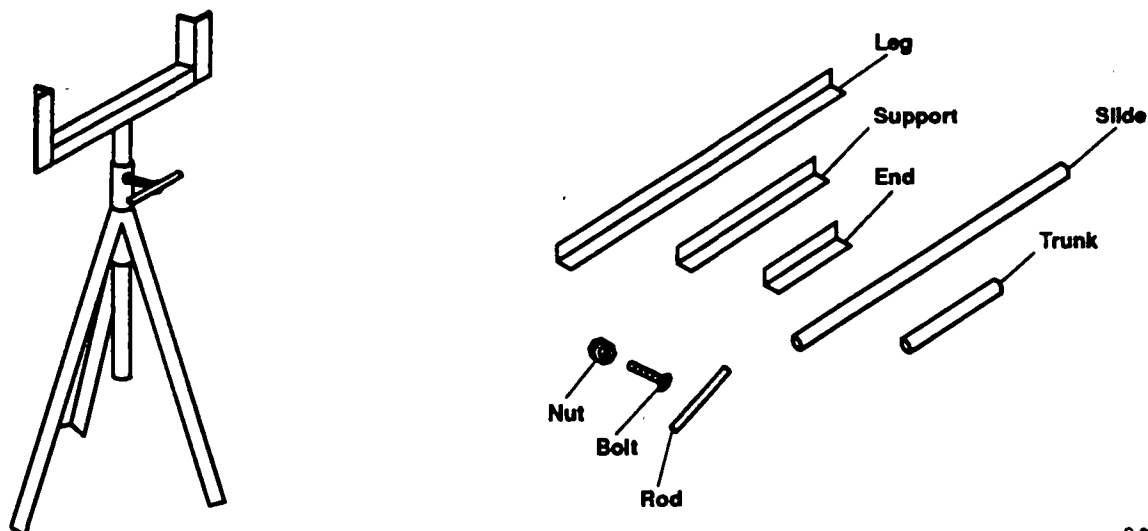
Figure 9-3. Material For Shop Stool

Table 9-2. Shop Stool Material List

Part	# Req'd	Size	Description
Leg	4	22 in. (558.8 mm)	1 in. (25.4 mm) Angle Iron
Bottom Frame	4	12-1/2 in. (317.5 mm)	1 in. (25.4 mm) Angle Iron
Top Frame	4	11 in. (279.4 mm)	1 in. (25.4 mm) Angle Iron
Top	1	13 x 13 in. (330.2 x 330.2 mm)	1/2 in. (12.7 mm) Plywood
Bolt	4	1 in. (25.4 mm)	Suitable Bolts
Nut	4	—	Matching Nuts

1. Cut materials according to the material list, Table 9-2, and Figure 9-3. Smooth sharp edges.
2. Drill hole through center of each of the top frame pieces.
3. Weld the four top frame pieces to form a square.
4. Weld the four bottom frame pieces to form a square.
5. Weld legs to top and bottom frames. Be sure to position legs for maximum stability.
6. Drill holes in the top to match holes drilled in Step 2.
7. Use bolts and nuts to attach top to top frame.

9-4. ADJUSTABLE SUPPORT/STAND



S-0212

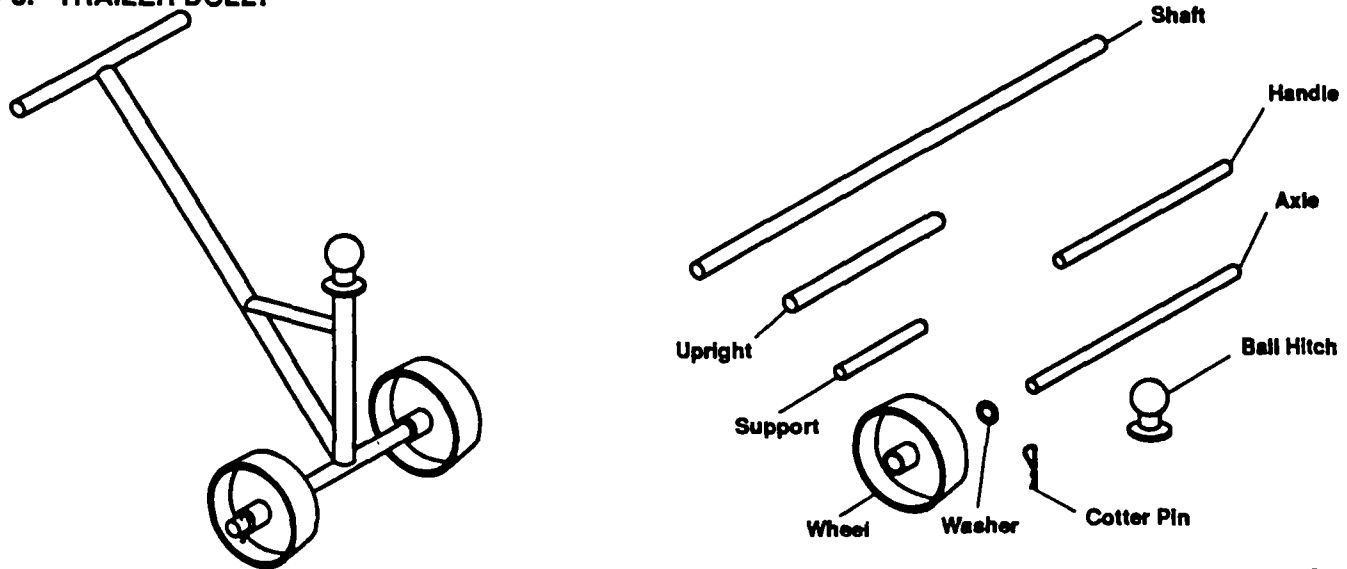
Figure 9-4. Material For Adjustable Support/Stand

Table 9-3. Adjustable Support/Stand Material List

Part	# Req'd	Length	Description
Leg	3	23 in. (584.2 mm)	1 in. (25.4 mm) Angle Iron
Support	1	10 in. (254 mm)	1-1/4 in. (31.7 mm) Angle Iron
End	2	4 in. (101.6 mm)	1-1/4 in. (31.7 mm) Angle Iron
Slide	1	18 in. (457.2 mm)	1 in. (25.4 m) Pipe
Trunk	1	6 in. (152.4 mm)	1-1/4 in. (31.7 mm) Pipe
Rod	1	3 in. (76.2 mm)	1/4 in. (6.3 mm) Rod
Bolt	1	1 in. (25.4 mm)	Hex Head Bolt
Nut	1	—	Hex Head Nut To Match Bolt

1. Cut materials according to the material list, Table 9-3, and Figure 9-4. Smooth sharp edges.
2. Weld end pieces to support.
3. Weld end of slide to support and bottom edge of support to slide.
4. Drill a hole large enough to accommodate bolt 1 in. (25.4 mm) from one end of the trunk.
5. Align the nut over the hole and weld it in place.
6. Weld legs to trunk being sure they are evenly spaced around the trunk and located at the proper angle to provide stability.
7. Place slide into trunk.
8. Weld rod to head of bolt.
9. Adjust stand to desired height.
10. Insert bolt and tighten.

9-5. TRAILER DOLLY



S-0213

Figure 9-5. Material For Trailer Dolly

Table 9-4. Trailer Dolly Material List

Part	# Req'd	Length	Description
Shaft	1	30 in. (762 mm)	1 in. (25.4 mm) Pipe
Handle	1	10 in. (254 mm)	3/4 in. (19 mm) Pipe
Support	1	7 in. (177.8 mm)	5/8 in. (15.9 mm) Pipe
Axle	1	14-1/2 in. (368.3 mm)*	3/4 in. (19 mm) Rod
Upright	1	9-1/2 in. (241.3 mm)	1 in. (25.4 mm) Pipe
Wheel	2	—	8 in. (203.2 mm) Wheels
Washer	4	—	1-1/2 in. (38.1 mm) Washers
Pin	2	—	2 in. (50.8 mm) Cotter Pins
Ball	1	—	Trailer Ball

*Size axle to wheels.

- Cut materials according to the material list, Table 9-4 and Figure 9-5. Smooth sharp edges.
- Drill holes for cotter pins in both ends of axle.
- Put wheel assembly together. Slide one washer, wheel, and another washer to each end of the axle. Install cotter pins. Allow room for wheel rotation, and mark the location of the inside washer on each end of the axle. Take apart the wheel assembly.
- Weld one washer to the axle at each of the marked locations.
- Flatten both ends of shaft.
- Weld handle to one end of shaft.
- Weld the other end of the shaft to the center of axle.
- Flatten one end of upright.
- Weld the flattened end of upright to axle. Upright should be positioned next to and at a 45 degree angle to shaft.
- Position brace between upright and shaft. Weld into place.
- Insert trailer ball into upright.
- Put wheel assembly together. Slide wheel, and another washer to each end of the axle. Secure wheels in place with cotter pins by bending both legs of cotter pin around the axle in one direction or by bending one leg clockwise and the other leg counterclockwise. Legs should conform to contour of axle as tightly as possible.

SECTION 10 – WELDING TECHNIQUES & TROUBLESHOOTING



CAUTION: WELDING CURRENT can damage vehicle components and other electronic components.

- *Disconnect both battery cables before welding on a vehicle.*
- *Place work clamp as close to the weld as possible to avoid long electrical paths.*
- *Be sure gun to power source as well as cable connections to work clamp are clean and tight.*
- *To minimize risk, disconnect the computer(s) from the vehicle.*

10-1. GAS METAL ARC WELDING (GMAW) – CONTINUOUS SEAM

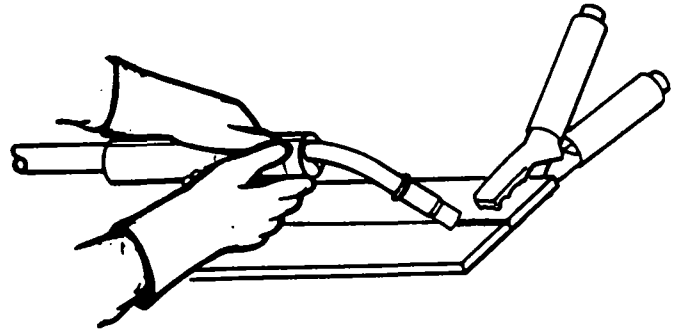


Figure 10-1. Continuous Seam

The ability to produce a good bead while using the Continuous Seam Gas Metal Arc process is dependent on several factors. One of the most important, after wire and shielding gas selection, is the way the gun is held. Cradle the gun in one hand and rest the side of the hand on the workpiece (avoid doing this on hot material); use other hand to hold gun and control the gun trigger. Position the gun either toward or away from the body at a 45 to 60 degree lead angle (see Figure 8-2). This will give a good view of the arc and make it easier to follow the seam while wearing a helmet. Maintain a 1/4 to 5/16 inch (6-8 mm) distance from the bottom of the gun nozzle to the workpiece during the arc starting and welding period. Do not pull the gun back from the seam when the arc starts, as this will create a long wire extension and result in a poor weld.

The welding wire is not energized until the trigger is pressed. Therefore the welding wire can be extended 1/4 inch (6 mm) beyond the gun nozzle and placed on

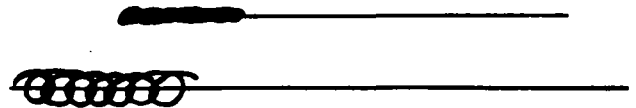
the seam before lowering the helmet and pressing the gun trigger.



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Figure 10-2. Gun Position

The gun can be moved along the seam in a steady movement known as the drag technique (see Figure 8-3), or it can be oscillated a few degrees beyond each side of the seam. The travel speed will be regulated by the type of weld bead required, the thickness of the material, welding current selected and the technique used. However, the average speed is 15 to 20 inches per minute (0.4-0.5 mpm).



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Figure 10-3. Welding Techniques

Other welding techniques that affect the weld characteristics in the GMAW welding process include the backhand and forehand technique, and the vertical up and vertical down positions. In the backhand technique the gun is positioned so that the electrode wire is feeding in the opposite direction of arc travel. The filler metal is being fed into the weld metal previously deposited. In the forehand technique the gun is angled so that the electrode wire is fed in the same direction as the arc travel. The backhand technique generally yields a more stable arc and less spatter on the workpiece.



Direction of Arc Travel →

Backhand Technique



← Direction of Arc Travel

Forehand Technique

Figure 10-4. Longitudinal Gun Positions

The vertical up and/or vertical down techniques describe the direction of arc travel when the welding must be done in the vertical position. In both of these techniques gun positioning is extremely important because the arc must be kept on the leading edge of the puddle to ensure com-

plete weld penetration. The drag technique is generally employed when welding in the vertical position, but when bridging a gap, the arc can be oscillated from one side of the work to the other.



Vertical Up



Vertical Down

Figure 10-5. Welding In The Vertical Up And Vertical Down Position

10-2. TROUBLESHOOTING THE GAS METAL ARC WELDING (GMAW) PROCESS

A. Porosity



Figure 10-6. Porosity

Possible Causes	Corrective Actions
1. Inadequate shielding gas coverage.	Remove spatter from the gun nozzle.
	Check gas hoses for leaks.
	Eliminate drafts (from fans, open doors, etc.) blowing into the welding arc.
	Place nozzle 1/4 to 5/16 in. (6-8 mm) from workpiece.
	Increase gas flow to displace all air from the weld zone.
	Decrease excessive gas flow to avoid turbulence and the entrapment of air in the weld zone.
	Hold gun at end of weld until molten metal solidifies.
	Check for frozen CO ₂ regulator/flowmeter.
2. Wrong gas.	Use welding grade shielding gas.
3. Dirty welding wire.	Use clean and dry welding wire.
	Eliminate pick up of oil or lubricant on welding wire from feeder or conduit.
4. Workpiece dirty.	Remove all grease, oil, moisture, rust, paint, undercoating, and dirt from work surface before welding.
	Use a more highly deoxidizing welding wire.
5. Welding wire extends too far out of nozzle.	Welding wire should extend 1/4 in. (6 mm) out of nozzle.

B. Excessive Spatter

Possible Causes	Corrective Actions
1. Excessive spatter when using CO ₂ shielding gas.	Select lower voltage range or adjust WIRE FEED SPEED control.

C. Incomplete Fusion



Figure 10-7. Incomplete Fusion

Possible Causes	Corrective Actions
1. Workpiece dirty.	Clean weld surfaces of impurities (grease, oil, moisture, rust, paint, dirt, etc.) prior to welding.
2. Insufficient heat input.	Select higher voltage range or adjust WIRE FEED SPEED control.
3. Improper welding technique.	When using a weaving technique dwell momentarily on the side walls of the groove.
	Provide improved access at root of joints.
	Keep electrode directed at the leading edge of the puddle.
	Provide proper gun angle (see Section 7-1).

D. Lack of Penetration



Figure 10-8. Lack of Penetration

Possible Causes	Corrective Actions
1. Improper joint preparation.	Material too thick. Joint preparation and design must be adequate to provide access to the bottom of the groove while maintaining proper welding wire extension and arc characteristics.
2. Improper weld technique.	Maintain normal gun angle to achieve maximum penetration (see Section 7-1).
	Keep arc on leading edge of the puddle.
3. Insufficient heat input.	Select higher voltage range and wire speed.
	Reduce the travel speed.
	Be sure welding wire extends 1/4 in. (6 mm) out of nozzle.

E. Excessive Penetration (Burn-Through)



Figure 10-9. Excessive Penetration

Possible Causes	Corrective Actions
1. Excessive heat input.	Select lower voltage range and reduce wire speed.
	Increase travel speed.

F. Cracks In Weld Metal

Possible Causes	Corrective Actions
1. Improper joint preparation.	Material too thick. Joint preparation and design must be adequate to provide access to the bottom of the groove while maintaining proper welding wire extension and arc characteristics.
2. Heat input too high causing excessive shrinkage and distortion.	Select lower voltage range and reduce wire speed.
	Increase travel speed.

G. Waviness of Bead



Figure 10-10. Waviness of Bead

Possible Causes	Corrective Actions
1. Welding wire extends too far out of nozzle.	Welding wire should extend 1/4 in. (6 mm) out of nozzle.
2. Unsteady hand.	Support hand on solid surface.

H. Humping



Figure 10-11. Humping

Possible Causes	Corrective Actions
1. Excessive heat input.	Select lower voltage range or increase travel speed.
	Weld in small segments and allow to cool between welds.

SECTION 11 – AUTO BODY REPAIR APPLICATION



CAUTION: WELDING CURRENT can damage vehicle computers and other electronic components.

- *Disconnect both battery cables before welding on a vehicle.*
- *Place work clamp as close to the weld as possible to avoid long electrical paths.*
- *Be sure gun to power source as well as cable connections to work clamp are clean and tight.*
- *To minimize risk, disconnect the computer(s) from the vehicle.*

11-1. POINTERS FOR WELDING AUTO BODY SHEET METAL

Before using this equipment to weld on a finished piece of work, make a few practice welds on a sample piece of material the same as that of the finished workpiece. Whenever possible, weld in the flat position since this is the easiest position to learn. Be sure that the material to be welded is clean and free of paint and rust. The work cable clamp must be attached to the parts being welded. Clean surface to ensure proper grounding and to complete the current path.

Use a .023 in. (0.6 mm) E70S-6 wire and argon/carbon dioxide shielding gas.

Use direct current straight polarity (electrode negative) for reduced burn through. Check position of gun polarity changeover jumper links according to information found in a separate section previously covered in this manual. If necessary, reposition jumper links.

IMPORTANT: *For maximum penetration on thicker materials such as 18 gauge (1.22 mm) and thicker, reconnect for direct current reverse polarity (work lead to negative, electrode wire to positive).*

11-2. PROCEDURE FOR WELDING MILD STEELS

The following are some basic guidelines that can be used when using this welding power source to weld mild or high strength steels:

1. Use a power wire brush or sander to remove paint to bare metal in the area to be repaired. Two to three inches (51-76 mm) on either side of the weld area should be cleaned for applying body filler after welding is completed.
2. Remove damaged metal using hand cutters, shears, or a power hand grinder equipped with a cutting wheel.
3. Fit a new piece of sheet steel over the section which was removed. The new material should overlap the cut away section by one inch (25 mm).
4. Clamp the new metal in place, and prepare to spot weld.

5. Place the VOLTAGE ADJUSTMENT switch in the 3 position.
6. Install the spot nozzle on the gun.
7. With the shielding gas and power source turned on, place the spot nozzle and press firmly against the new material about 1/2 to 3/4 in. (12-18 mm), from the edge. Fit up must be tight to assure good, repeatable spot welds.
8. Begin spot welding from the center out on each side. Distortion may occur if welding begins at the corners.
9. Space spot welds 1 to 1/2 in. (25-38 mm) apart around repair. Spot welds should be about 3/16 in. (5 mm) in diameter.

IMPORTANT: *Do not make continuous welds around the repair as this will promote distortion and warpage.*

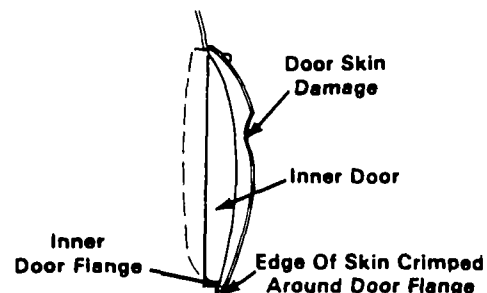
10. After welding, remove the clamp and grind spot flush to surface.
11. Smooth the joints with body filler and finish.

11-3. PROCEDURES FOR WELDING DOOR PANELS

IMPORTANT: *Every experienced autobody repairman will have his own method of performing the following procedures. However, this information is presented to show how, in most cases, this welding power source can make the job easier and less time consuming.*

If the door is severely damaged, but the damage is primarily in the outer panel, or "skin", the door can be easily repaired without necessarily installing a whole new door.

1. Remove exterior molding and hardware. It is not necessary to remove window regulator, remote control mechanisms, lock or runs.
2. Remove door assembly, and place on flat surface with edge of door extending over edges of surface to provide room to work.

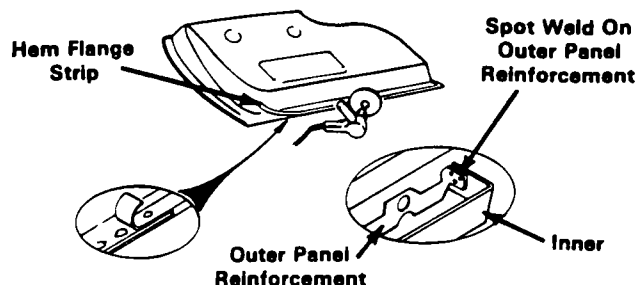


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Figure 11-1. Cutaway Of Door Panel Damage

3. If door has an outer panel reinforcement, break the weld.
4. Grind off the hem flange and remove the old panel.

5. Repair any damage to the inner panel.
6. Position the new outer panel over door and bend the end flange over the inner flange.
7. Spot weld outer panel reinforcement to new door panel.
8. Spot weld new hem flange to inner panel.
9. Metal finish exterior surface, paint and assembly interior trim and hardware.



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Figure 11-2. Hem Flange Removal

11-4. HOW TO PREVENT GLASS BREAKAGE AND SPATTER ON WINDOWS

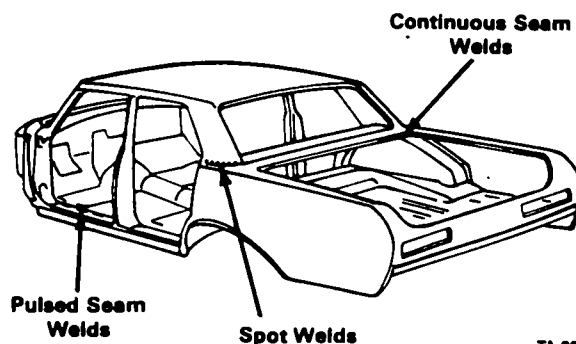
Spatter and excessive heat can become problems when welding near windows. Protect the windows by keeping them covered and as far away from the heat zone as possible. When welding must be performed near windows, the windows should be covered and protected from excessive heat by using wet rags. A putty like substance which reduces heat transfer is available through your welding supplier. If burn through and spatter become problems, ensure that the correct voltage tap is being used for the size material being welded. Use an argon and CO gas mixture and check travel speed.

11-5. PROCEDURES FOR WELDING FENDERS AND QUARTER PANELS

When a complete panel must be replaced it will be necessary to remove the bolts securing the panel to the rest of the structure, or to cut through the spot welds if the panel is welded in place. In most cases a front fender will be bolted in place, while the other panels will be either spot welded or continuous seam welded. The alignment of front fenders is usually simple because the bolt holes are often elongated so that the position of the new front fender can be shifted and correctly aligned. Generally all other panels are welded into place.

If the whole panel is to be replaced, the old panel must be removed by cutting along the weld if welded by continuous seam, or by drilling out the spot welds if it is spot welded in place. Car and body manufacturers have the panels welded in different places, so it will be necessary to inspect the body to determine where the welds are located in each case. After the old panel is removed, the

inner panels must be carefully checked, straightened or replaced.



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Figure 11-3. Automotive Body Sections Assembled With Continuous Seam, Pulsed, And Spot Welds

The new outer panel can then be placed and held in position by vice-grips or c-clamp. When welding, start at the center and proceed first in one direction and then the other. In order to ensure reduced distortion due to heat, weld only a section of 2 or 3 in. (51-76 mm) at a time. It is important to constantly check the over all temperature of the sheet steel around the welding area, because it is in this concentrated heat area that warpage and distortion will begin. Leave a gap and then weld another short section. When the weld is completed it can be hammered down, filled with body putty and sanded.

11-6. WELDING FRAMES AND HIGH STRENGTH (HSS) STEELS

The new HSS steels are used on many of the new economy compact cars. HSS steels can be found in the steel gussets, brackets, floor pans, and support members of these new models. HSS steels are thinner for weight reduction and are heat sensitive. As heat is applied, the strength decreases and cracking can occur, therefore the heat affected zone must be kept as small as possible. For this reason the GMAW welding process has become the preferred method for welding HSS steels, and the oxacetylene welding or brazing processes, with its wider heat affective area, are normally not recommended.



Figure 11-4. Application Of Body Putty

SECTION 12 – PARTS LIST

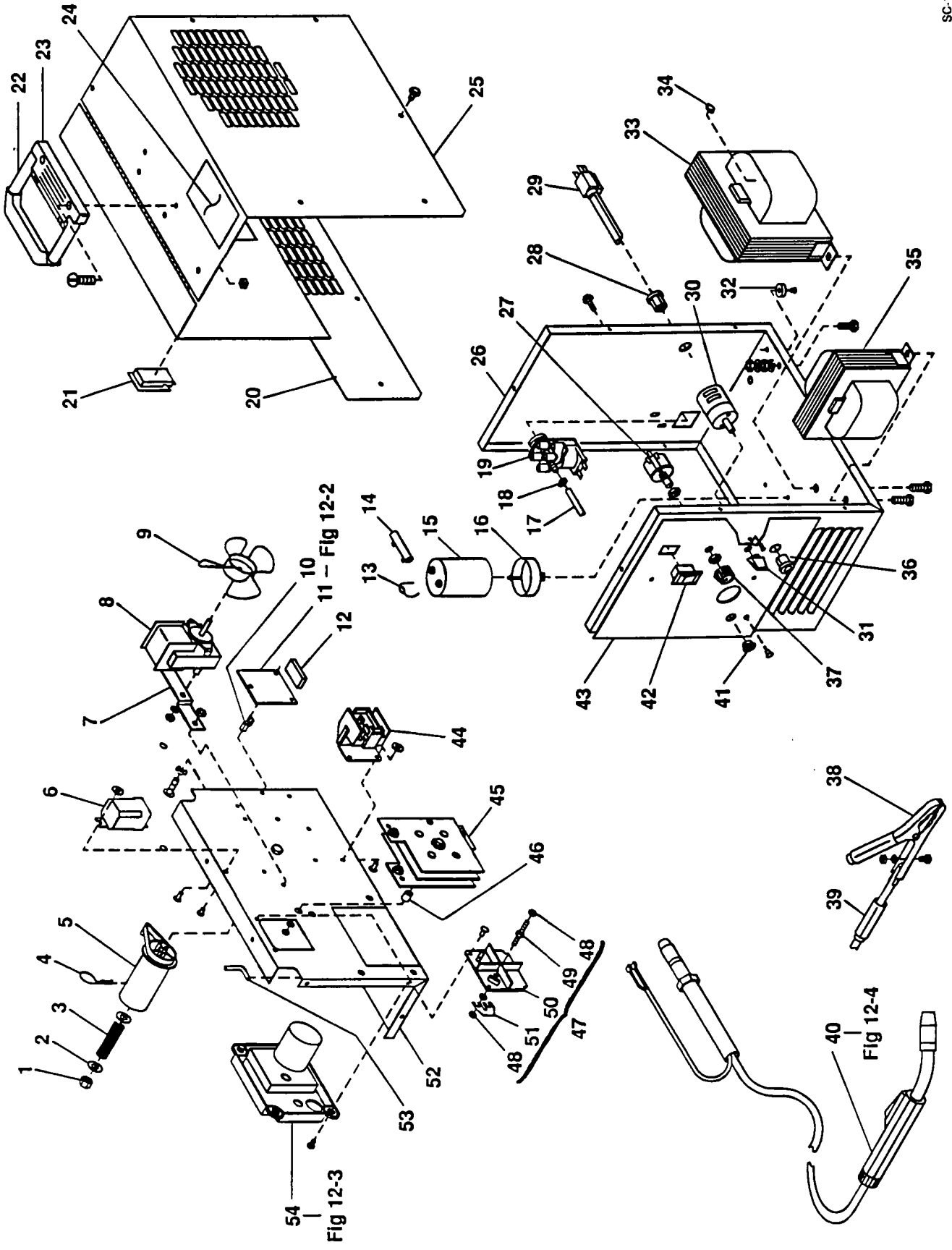


Figure 12-1. Main Assembly (Benchmark Pro Illustrated)

Item No.	Dia. Mkgs.	Part No.	Description	Quantity	
Figure 12-1. Main Assembly				Benchmark	Benchmark Pro
1		010 909	NUT, stlkg hex .375-16	1	1
2		010 910	WASHER, flat - SAE .375	2	2
3		073 355	SPRING, compression .437 ID x .625 OD x 1.000	1	1
4		111 998	PIN, cotter .120 dia x 2.375	1	1
5		111 929	HUB, spool	1	1
6	CR1	120 706	RELAY, encl 24VAC DPDT	1	
6	CR1	006 393	RELAY, encl 24VAC DPDT		1
7		120 675	BRACKET, mtg - fan motor	1	1
8	FM	111 931	MOTOR, fan 120V 50/60 Hz 2600 RPM	1	1
9		005 656	BLADE, fan 6 in 4 wing 30 deg	1	1
10		110 375	STAND-OFF SUPPORT, No. 6 scr		3
11	PC1	119 539	CIRCUIT CARD, shutdown/burnback (Fig 12-2)		1
12	PLG2	118 936	HOUSING, term header 10 pin		1
13	VR1	087 156	VARISTOR, 10 joule 68VDC	1	1
14	R2	117 116	RESISTOR, WW fxd 20W 50 ohm	1	1
15	C1	109 039	CAPACITOR, elctt 46000uf 35VDC	1	1
16		108 105	CLAMP, capacitor 2.500 dia	1	1
17		604 550	HOSE, brd No. 1 x .187 ID (order by ft)		3ft
18		089 120	CLAMP, hose .375-.450 dia		2
19	GS1	116 996	VALVE, 115VAC 2 way 1/4 IPS port 1/8 orf		1
		605 277	NUT, nyl hex jam .750 NPSR	1	1
20		119 116	PANEL, side	1	1
21		089 899	LATCH	1	1
22		126 416	HANDLE, molded plastic	1	1
23		126 415	CLAMP, saddle alum ally 380-3	1	1
24		121 316	LABEL, warning general precautionary	1	1
25		+128 667	WRAPPER	1	1
26		119 120	CASE SECTION, base/front/rear	1	1
		059 712	CLIP, component .437 mtg	1	1
27	R1	119 653	RHEOSTAT, WW 25W 50 ohm	1	
27	R1	000 101	RHEOSTAT, WW 50W 16 ohm		1
28		111 644	BUSHING, strain-relief .370/.430 ID x .875 mtg hole	1	1
29	PLG1	120 964	CORD SET, pwr 300V 14ga 3/c 7ft	1	
29	PLG1	113 494	CORD SET, pwr 300V 14ga 3/c 7ft		1
30	S2	111 897	SWITCH, rotary 4 posn 600V (consisting of)	1	1
31		127 023	· KNOB, pointer	1	1
32		019 663	MOUNT, 15/16 OD x 3/16 x 3/8	4	4
33	T1	119 825	TRANSFORMER, main 115 (consisting of)	1	
		118 090	· COIL	1	
33	T1	124 849	TRANSFORMER, main 115 (consisting of)		1
		123 411	· COIL		1
34	TP1	120 638	THERMOSTAT, NC	1	
34	TP1	125 552	THERMOSTAT, NC		1
35	Z	118 457	STABILIZER	1	1
36		111 443	BUSHING, strain - relief .240/.510 ID x .875 mtg hole	1	1
37		097 922	KNOB, pointer	1	1
38		010 368	CLAMP, grd 100A	1	1
39		026 843	INSULATOR, vinyl blk-43	2	2
40		Fig 12-4	GUN, MWG-160B	1	1
41		025 338	BUSHING, 23/32 dia x .625	1	1
42	S1	111 997	SWITCH, rocker SPST 10A 250VAC	1	1
43			NAMEPLATE, (order by model & serial number)	1	1
44	CR2	129 696	CONTACTOR, 25A 1P 25VAC coil		1
45	SR2	119 264	RECTIFIER, si 1 ph 100A	1	1
46		010 047	TUBING, stl .625 OD x 12 ga x 1.000	1	1

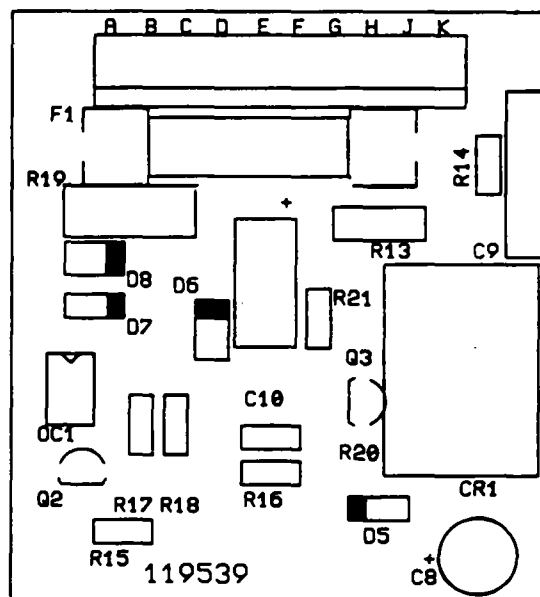
Item No.	Dia. Mkgs.	Part No.	Description	Quantity	
Figure 12-1. Main Assembly (Continued)				Benchmark	Benchmark Pro
47	TE1	122 385	TERMINAL ASSEMBLY, changeover (consisting of)	1	1
48		601 835	· NUT, brs hex 10-32	8	8
49		038 887	· STUD, pri bd brs 10-32 x 1.375	4	4
50		116 620	· TERMINAL BOARD	1	1
51		038 618	· LINK, jumper	2	2
52		130 900	BAFFLE, air	1	1
53		603 107	HOSE, nprn .156 ID (order by ft)	1ft	1ft
54		Fig 12-3	DRIVE ASSEMBLY, wire	1	1
		089 120	CLAMP, hose .375-.450 clp dia	2	2
		113 129	TUBING, PVC .250 ID x .062 (order by ft)	4ft	4ft
		112 863	FITTING, adapter hose	1	1
	F1	*012 663	FUSE, mintr gl slo-blo 3A	1	
		053 297	HOLDER, fuse - crtg	1	
		120 077	BLANK, snap-in sq 1.250	1	

+When ordering a component originally displaying a precautionary label, the label should also be ordered.

*Recommended Spare Parts.

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

Item No.	Part No.	Description	Quantity
PC1	119 539	Figure 12-2. Circuit Card, Shutdown/Burnback (Fig 12-1 Item 11)	
C8	111 944	CAPACITOR, elctlt 68uf 35VDC	1
C9	044 176	CAPACITOR, cer .01uf 1000VDC	1
C10	028 290	CAPACITOR, elctlt 1uf 50VDC	1
CR1	099 018	RELAY, encl 24VDC SPDT	1
D5	028 351	DIODE, sig .020A 75V SP	1
D6,8	026 202	DIODE, 1A 400V SP	2
D7	037 084	DIODE, zener 4.7V 1W SP-55	1
F1	*073 426	FUSE, mintr gl slo-blo 5A	1
OC1	114 712	IC, interface 11C1	1
Q2	114 714	TRANSISTOR, PNP 200MA 80V	1
Q3	114 713	TRANSISTOR, NPN 200MA 80V	1
R13	028 285	RESISTOR, C .5W 100 ohm	1
R14	035 823	RESISTOR, CF .25W 100 ohm	1
R15	039 331	RESISTOR, CF .25W 4.7K ohm	1
R16,21	035 827	RESISTOR, CF .25W 10K ohm	2
R17	039 328	RESISTOR, CF .25W 1.5K ohm	1
R18	039 334	RESISTOR, CF .25W 27K ohm	1
R19	030 843	RESISTOR, C 1W 680 ohm	1
R20	039 335	RESISTOR, CF .25W 47K ohm	1
RC1	118 935	TERMINAL, header 10 pin	1

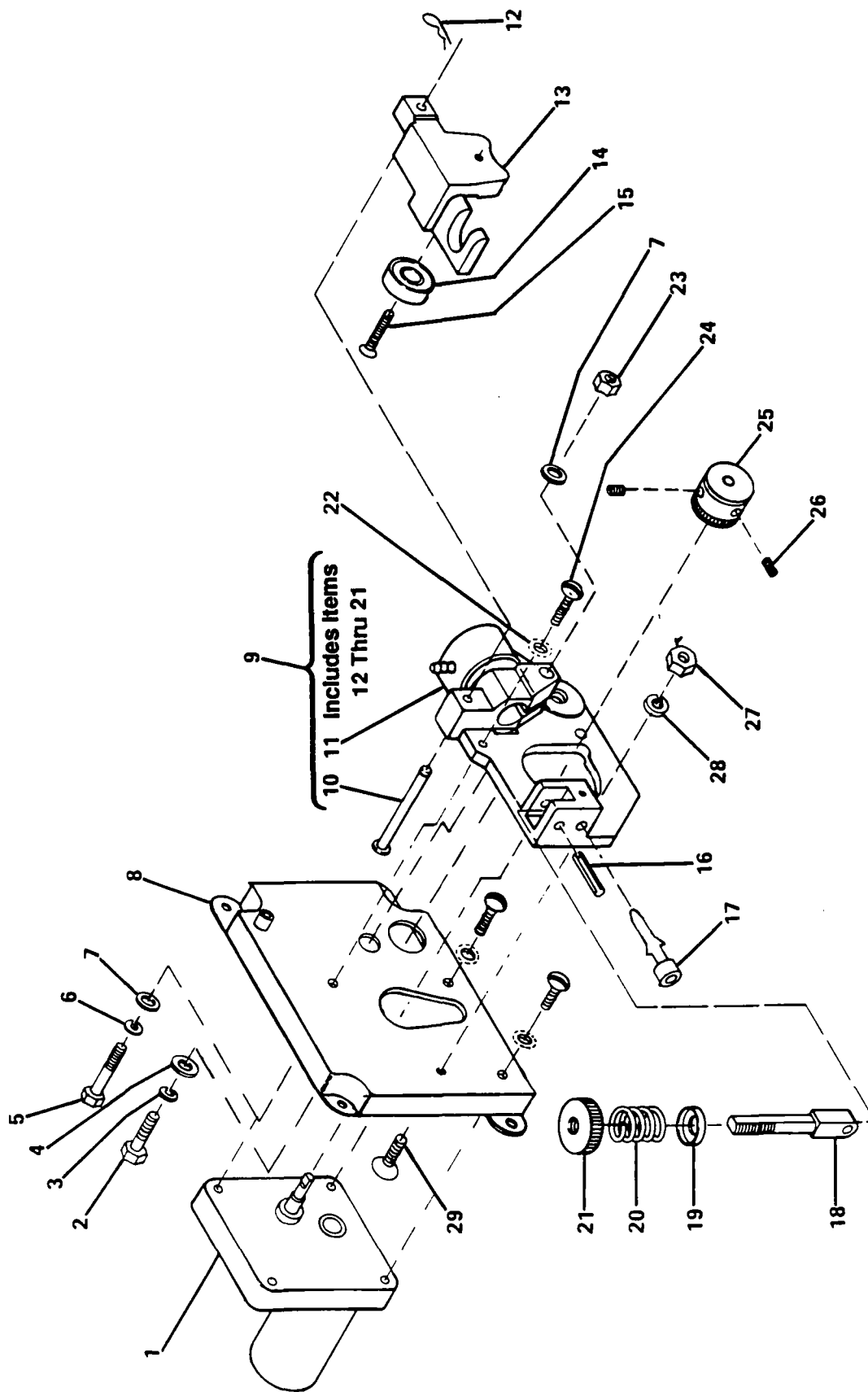


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Figure 12-2. Circuit Card, Shutdown/Burnback PC1

*Recommended Spare Parts.

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.

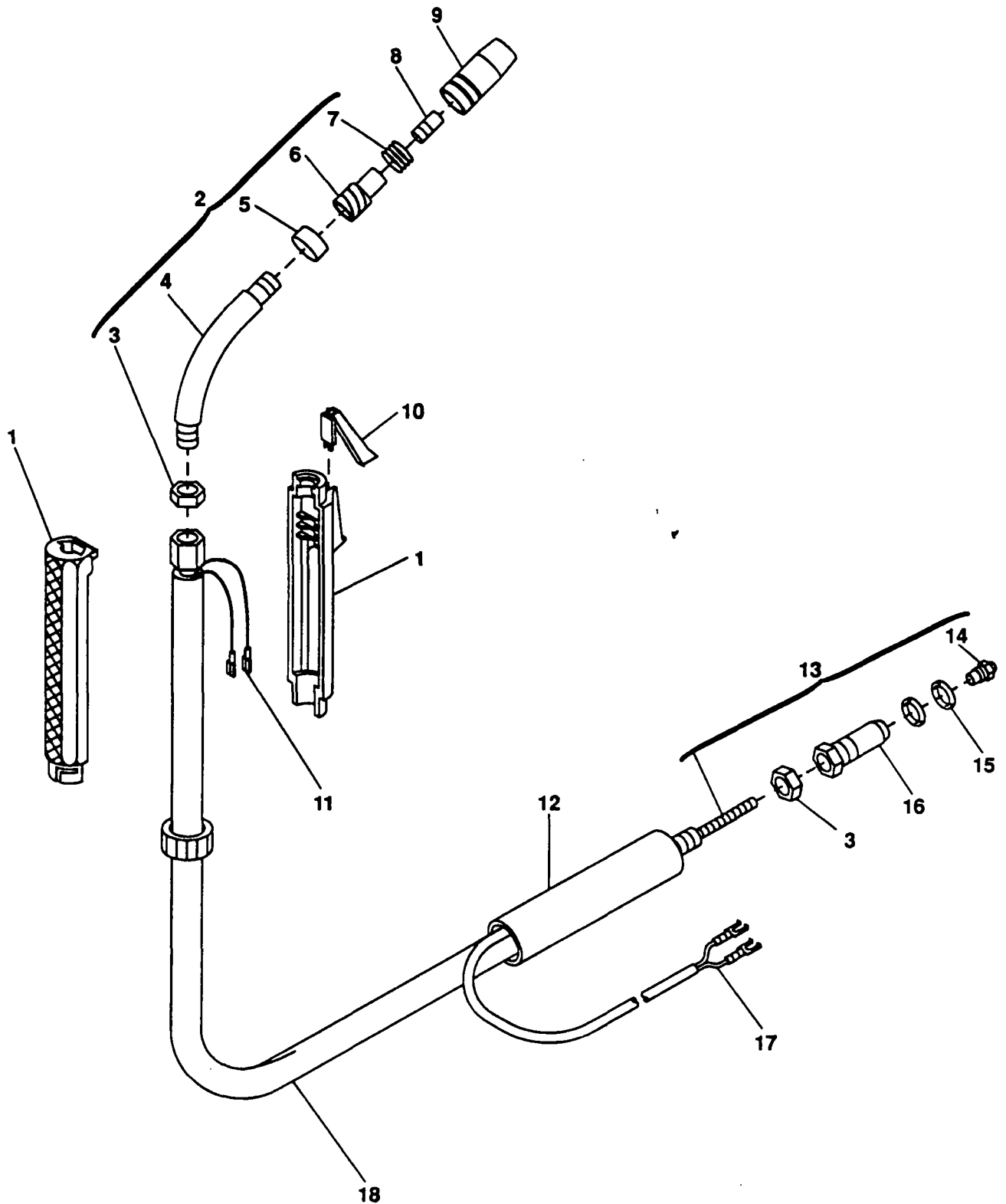


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Figure 12-3. Drive Assembly, Wire (Benchmark Pro Illustrated)

Item No.	Dia. Mkgs.	Part No.	Description	Quantity
Figure 12-3. Drive Assembly, Wire (Fig 12-1 Item 54)				
1	MOT	119 021	MOTOR, gear 12VDC 80RPM (Benchmark)	1
1	MOT	124 506	MOTOR, 12VDC 100RPM (Benchmark Pro)	1
2		604 657	SCREW, cap - hex hd .375-16 x 1.250	1
3		602 213	WASHER, lock-split .375	1
4		010 910	WASHER, flat - SAE .375	1
5		128 189	SCREW, cap - hex hd .312-18 x 1.750	1
6		602 211	WASHER, lock - split .312	1
7		604 538	WASHER, flat - SAE .312	2
8		129 893	INSULATOR, housing - drive	1
9		126 838	WIRE DRIVE, (consisting of)	1
10		090 416	· PIN, hinge	1
11		124 817	· HOUSING	1
12		604 741	· PIN, cotter-hair .042 x .937	1
13		112 031	· LEVER, pressure - roll	1
14		111 523	· BEARING, ball	1
15		114 415	· SCREW, stl phillips-flat hd 10-24 x .625	1
16		010 224	· PIN, spring .187 x 1.000	1
17		058 549	· GUIDE, wire - inlet 1/16	1
18		085 242	· FASTENER, pinned	1
19		085 244	· WASHER, cupped .328 ID x .812 OD x .125	1
20		090 415	· SPRING, compression .720 OD x 1.250	1
21		092 237	· KNOB, adj-tension	1
22		602 204	WASHER, lock - ext tooth No. 10	3
23		604 537	NUT, hex - full fnsh .312-18	1
24		605 853	SCREW, rdh 10-32 x .750	3
25		119 028	ROLL, drive - V groove	1
26		602 169	SCREW, set-skt hd 8-32 x .187	2
27		601 862	NUT, hex 10-32	1
28		602 203	WASHER, lock - split No. 10	1
29		602 096	SCREW, flhd 10-32 x .750	1

BE SURE TO PROVIDE MODEL AND SERIAL NUMBER WHEN ORDERING REPLACEMENT PARTS.



Ref. SC-110 832

Figure 12-4. Exploded View Of MWG-160B

Item No.	Part No.	Description	Quantity
Figure 12-4. Exploded View Of MWG-160B (Fig 12-1 Item 40)			
1	110 793	HANDLE ASSEMBLY	1
2	110 795	TUBE, head (consisting of)	1
3	110 780	· NUT, M 10 x 1	2
4	110 779	· JACKET, hd tube	1
5	110 781	· STOP, nozzle	1
6	128 878	· ADAPTER, headtube/nozzle	1
7	118 571	· SPRING, nozzle	1
8	112 743	TUBE, contact .024 wire	1
8	112 751	TUBE, contact .030 wire	1
8	121 935	TUBE, contact .035 wire	1
9	110 789	NOZZLE, slip type 1/2 orf	1
10	110 794	TRIGGER SWITCH ASSEMBLY	1
11	080 565	TERMINAL, friction-female .110 x .016 22-18 wire	2
12	110 797	SLEEVE, rbr	1
13	110 783	LINER, .023-.030 wire (consisting of)	1
14	110 784	· COLLET, liner .023-.030 wire	1
13	121 905	LINER, .030-.035 wire (consisting of)	1
14	120 715	· COLLET, liner .035 wire	1
15	079 974	O-RING, 1/2 ID x .103	2
16	110 796	CONNECTOR, gun/feeder	1
17	047 994	TERMINAL, friction-female .250 x .032 22-18 wire	2
18	110 792	CABLE/CONDUIT, 10 ft	1

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